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M-SSP BACKUP

MARKET IMPACT OF NEW SOFTWARE PRODUCTIVITY TECHNIQUES

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NEW SOFTWARE PRODUCTIVITY TECHNIQUES

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M-55P-I

I INTRODUCTION

• This report focuses on some major issues and problems that are of high importance in understanding the market impact of new software productivity techniques.

o ~~This report~~ It ~~depends upon~~ borrows from several other INPUT reports ~~for~~ concepts and terminology. Two of the most important are: Improving the Productivity of Systems and Software Implementation, November 1980; and Market Impacts of IBM Software Strategies, published ~~earlier this year~~ in 1984. In addition, the research program for this report is described in more detail ~~in the~~ in its companion ~~to this~~ report; New Opportunities for Software Productivity Improvements.

o Improving the Productivity of Systems and Software Implementation was the result of a major INPUT multiclient study. That study identified five major components of a comprehensive productivity improvement program. These components and their definitions are as follows:

- Commitment to quality was determined to be essential if "failures" and excessive maintenance were to be avoided.

- User involvement was deemed ~~to be~~ necessary to assure quality. This component included: 1) direct user involvement in both systems development and operations; 2) understanding of what the proper role of the information systems (IS) function ~~was (what IS could and could not do, and~~ is; 3) awareness of how individual user needs fit into ~~larger~~ company requirements.

WP: subsub.

- Broad-based management of the IS function was ~~established as a means of~~ found to be effective in assuring both high quality systems and user involvement through

education. It was felt that broad-based management of the IS function would provide top management and users with knowledge of "nontechnical IS fundamentals" and IS management with broader perspective on corporate objectives.

- Effective personnel policies emphasized the importance of employee selection, retention, motivation, and development.

- The Right Tools ~~was described~~ were named as a means of achieving "~~micro-~~productivity," and it was ~~generally~~ concluded that selection of the right tools ~~be~~ is heavily ~~development~~ dependent upon the other components of the productivity program. ("Tools" was taken in the broadest sense and included everything from programmer terminals ~~through~~ to structured methodologies and information engineering.)

o Market Impacts of IBM Software Strategies introduced the ~~concepts~~ components of General Systems Theory (GST) as ~~they~~ it applies to systems software, and defined ~~from~~ four strategic ~~periods for~~ phases in IBM's software strategy.

WP: underline

GST has four relatively simple ~~concepts~~ components: centralization, integration, differentiation, and mechanization, ~~which~~ all proceed in parallel and therefore lead to complex ~~interactive~~ interaction. In their simplest form, these concepts are defined as follows:

WP: sub

- Progressive centralization: "Leading parts" tend to dominate the behavior of the system.

- Progressive integration: The parts become more dependent upon the whole.

- Progressive differentiation: The parts become more specialized.

- Progressive mechanization: Some parts become limited to a single function.

systems network architecture/distributed data processing

- The IBM strategic periods were designated as: SNA/DDP, electronic office, expert systems, and custom products. These strategic periods also proceed in parallel, and the labels were derived from IBM primary software emphasis during the ~~particular~~ relevant period. The fundamental definitions of these IBM strategic periods are as follows:

  - SNA/DDP: This period extends from the present to 1990, and represents IBM's evolutionary distribution of processing and data bases under the ~~great~~ SNA umbrella.

  - Electronic offices: This period extends from 1990 to 1995, and is characterized by the automation of office functions to the degree that paper documents become secondary to electronic information flow.

  - Expert systems: This period extends from 1995 to 2000, and will see the beginning of knowledge-based systems, stet in which software will include necessary information to support individual industries and/or professions.

  - Custom products: This period extends beyond 2000, and essentially represents the necessary integration, differentiation, and mechanization of hardware/software/information required to penetrate the individual consumer market--whether at home or in the office.

o It is within ~~a~~ the general structure defined by the productivity components, GST concepts, and IBM strategic periods that the research for this ~~specific~~ study was conducted. The research base used was as follows:

- The comprehensive productivity data base developed for the 1980 multiclient study provided the ~~primary~~ stet research ~~foundation~~ basis. (Fifty companies visited on-site; over 100 companies and 200 individuals interviewed; and 1,300 mail~~ed~~ surveys.)

- In addition ~~the study you are now reading~~ ~~For this study~~, over 50 carefully selected individuals were interviewed by telephone. These interviews were distributed as follows:

  - Thirty companies from the 1980 multiclient productivity study were interviewed.

  - Seven information systems directors from seven major industr~~y~~ies ~~who~~ that had participated as in-depth case studies for a custom productivity study in 1981 were re~~-~~interviewed to determine the status of their productivity improvement programs.

- The ~~ten~~ 10 computer services companies who specialize in productivity tools and aids were interviewed.

- Ten individuals prominent because of their efforts in productivity improvement (or because their specialties may be of significance in advanced tools and aids) were interviewed.

- In addition, extensive desk research was con~~cluded~~ducted in areas indicated as promising by past productivity research efforts.

o As a result of the analysis ~~which was required~~ performed for <u>Market Impacts of IBM Software Strategies</u>, it was concluded that the framework of GST concepts and IBM strategic periods would be an appropriate foundation for a refined forecasting methodology. This report will be the first to employ this new methodology, and it will be explained in detail in the body of the report.

II

II EXECUTIVE SUMMARY

- This executive summary is designed in presentation format in order to:

  - Help the reader review ~~the~~ a key research findings.

  - Provide ~~a ready-to-go~~ an executive presentation~~, complete with a~~ script, to facilitate group communications.

- The key points of ~~this~~ the entire report are summarized in Exhibits II-1 through II-6. On the left-hand page facing each exhibit is a script explaining the exhibits' contents.

- ~~This report focuses on some major issues and problems which are of extreme importance in understanding the impact of new software productivity techniques. In order for the summary presentation to be most meaningful,~~ it is ~~essential~~ recommended that the full report be read, in order to make most effective use of the summary presentation.

A. IMPACT OF NEW SOFTWARE PRODUCTIVITY TECHNIQUES

o The impact of new software productivity techniques manifests itself in an newly emerging ~~entirely new~~ systems development environment, ~~which is currently evolving~~. This environment is characterized by:

- Emphasis upon the establishment of the information center.

- Increased use of prototyping.

- The ~~continuing and~~ increasing acceptance of personal computers in the corporate environment.

- The demand for micro-mainframe links to extend the applications of microprocessor technology.

o INPUT calls this new environment Distributed Systems Development (DSD).

o The DSD environment holds great promise because it increases IS responsiveness, gets end users involved in software development, and produces early tangible results.

o However, there are potential problems which threaten to negate the promise. These problems are associated with data/information quality and security, and with performance at both the host and the intelligent workstations.

o While the problems present a challenge, this solution represents an opportunity for an increased market for improved productivity tools and aids.

Ex. II-1

B. THE GOOD NEWS

The idea of Fourth, fifth, and future ~~Fourth~~ generation languages

- FGLs ~~are~~ is not only being accepted, but the demand for continued advanced language development is beginning to be addressed by the emerging commercial products for artificial intelligence research. Specifically, the interest in expert systems is healthy and should be viewed as a substantial growth opportunity.

- Integration of FGLs with data base systems (and eventually knowledge-based systems) and code generators will enhance both their usefulness and market value.

- data base management systems
  Languages and DBMS are beginning to migrate to microcomputers, and this will accelerate with micro-mainframe links.

- Systems are getting more user friendly, and users are becoming more computer literate and involved in the systems development process.

- Tangible results in tersm of responsiveness for information and output from new systems are becoming available more rapidly. Pressure upon the IS function has been relieved in many instances, and user-IS relations have improved.

Ex. II-2

C. THE BAD NEWS

- IS management expressed real concern that the quality of data and information in ~~this~~ their companies could suffer as a result of the DSD environment. It is anticipated that investment in the DSD environment (both hardware and software) will divert resources from conventional data processing services, while making increased and unanticipated demands upon the central facility.

- The distribution of data basis is felt to be creating a new set of security, protection, and privacy problems before the old ones have ~~even~~ been solved.

- INPUT's analysis reveals that there is high potential for counter productive impacts in the DSD environment despite superficial indications of improved productivity. Specifically:

    - Essential corporate data may be contaminated and information quality may degenerate to the point of chaos.

    - The systems developed may be of such low quality and/or performance that they are ~~too costly to install~~ not worth installing. This could result in a higher percentage of systems being aborted later in the development cycle.

    - Just as bad, if not worse, is "eternal" systems development whereby excess maintenance is hidden in the unending development of partial solutions.

- ~~While~~ Whereas most of the anticipated problems are recognized by IS management DSD is proceeding without control; and, more important, some IS managers are waiting to say: "I told you so."

Ex. II-3

D. NEW TOOLS AND AIDS NEEDED TO CONTROL DSD

- Some new tools needed ~~to control quality in~~ the DSD environment are outlined in the report, are summarized below. ~~These tools were~~ are described primarily because they targeted windows of opportunity created by IBM's software strategy. En

- Information Base Management System (IBMS) ~~is a proposed~~ is a comprehensive system under proposal for identifying information sources within an organization (including paper-based and human information sources).

- Document Control System (DOCS) is a necessary subsystem under IBMS ~~which~~ that provides for tracking of paper documents and ~~providing~~ for a smooth transition to electronic offices. (Early use of optical disk for electronic filing is urged.)

- Data Flow Monitor (DFM) is an advanced network manager ~~which~~ that both monitors and controls data flow with special emphasis upon use ~~on the tools~~ of operations research (OR) and artificial intelligence (AI).

- It is INPUT's opinion that OR and AI must be reconnected if emerging expert systems are to be of practical value, and the quality problems of DSD may prove trivial compared to those of early expert systems. There is substantial need for practical research and development to supplement the spin-offs from the academic community.

- Any tool, aid, or software system which does not address the problems of security, protection, and privacy (SPP) will ~~soon~~ be obsolete once IBM makes its "solution" available. There is tremendous opportunity for a SPP system to handle distributed data bases.

Ex II-4

FGLs:

E. ~~IBM AND FGLs--THE~~ KEY~~S~~ TO THE DSD MARKET

o FGLs have paved the way for the DSD environment, and future language advances will continue to fuel the market for easy~~-~~to~~-~~use computer systems. INPUT's expanded definition of FGL includes expert systems as highly differentiated products. (Such systems had been viewed as ~~impacting~~ affecting FGL growth in the late 1980s.)

o Since FGLs ~~drive to~~ fuel the DSD environment, they contribute to the problems associated with that environment. Understanding the control problems will permit the extension and application of FGLs to ~~become part of~~ the solution ~~to the~~ of control problems and will actually expand the FGL market.

o Some of the proposed tools and aids for controlling the DSD environment can be initially implemented as applications using FGLs as "tools to build tools." This invisible market is substantial.

o The market impacts of IBM software strategies were described in the INPUT report of the same name. That report defined certain anticipated windows of opportunity occurring between IBM's strategic periods--specifically, between the current SNA/DDP period (1984-1989) and the electronic office period (1990-1995). STET ~~Use~~ See market impact of IBM software strategies ~~to determine~~ for STET specific targets of opportunity.

NP: underline title

o IBM has also been identified as a large potential market for software, especially in the electronic office period. Design future tools and aids with that in mind.

F. EXPANDED FGL MARKET FORECAST

- INPUT's original forecast for the FGL market ~~has~~ is contained in Trends and Opportunities in Fourth-Generation Languages. That forecast predicted growth from $750 million in 1984 to ~~$3,650 million~~ $3.7 billion in 1989, for an average annual growth rate of 37.~~2~~8%.

- By extending FGLs to include control tools and aids necessary for the DSD environment, that potential market is projected to expand to ~~$5,150 million~~ $5.2 billion by 1989, for an AAGR of 47%.

- This report also projects "effective markets," which ~~means~~ is the market ~~left~~ remaining after IBM has achieved its share. This particular market is especially attractive because it is predicted that IBM will only achieve 30% penetration (approximately ~~$1,500 million~~ $1.5 billion), as compared to 41% penetration for the overall applications development market (of which FGLs are a part). This means the original forecast of ~~$3,650~~ $3.7 billion represents an effective market.

- There is one caveat in this forecast--the problems isolated by the research for this report cast serious doubt that the original market forecast for FGLs could be achieved considering the problems which were identified. This forecast assumes those problems will be recognized and overcome. In other words the solutions to the problem which expand the market size are essential in order to maintain over "normal" FGL market growth. ?

Ex. II-6

III

III CURRENT APPROACHES TO SYSTEMS DEVELOPMENT

- Through INPUT's Information Systems Program (ISP), we ~~are able to remain current on~~ stay informed of productivity issues and developments among our client base. It ~~was~~ is our opinion that the major productivity initiatives which have been taken since INPUT completed its comprehensive multiclient productivity study ~~in 1980~~ (Improving the Productivity of Systems and Software Implementations, November 1980) fall into the following general categories:

  - Information centers.
  - Prototyping.
  - Personal computers.
  - Micro-mainframe links.

- Whether these initiatives were taken by the IS departments, promoted by hardware and software vendors, or seized by frustrated computer users is immaterial. The result has been that end users have become intimately involved in the systems development process--even to the degree of developing their own systems. INPUT refers to this perceived trend away from highly centralized, IS-dominated systems development as Distributed Systems Development (DSD).

- Theoretically, DSD should result in substantially improved productivity, but INPUT's continuing client contact also indicated that there was some apprehension among IS departments concerning direct user involvement. Therefore, the research for this study and its companion (New Opportunities for Software Productivity Improvements, to be published as part of INPUT's Information Systems Program) was designed to explore both positive and negative aspects of DSD. The questionnaire~~s~~ used ~~are~~ is included ~~in~~ as Appendix A, and ~~they~~ it clearly ~~indicate~~ indicates that the purpose of the research was directed toward~~s~~ determining what is being done to both ~~facilitate~~ promote and to control the DSD environment. Emphasis was placed on identification of problem areas~~,~~ and of the tools and aids required to facilitate and control software development in that environment.

Ref. App. A

A. THE CURRENT DSD ENVIRONMENT ~~CONFIRMED~~ DESCRIBED

- The trend toward~~s~~ DSD that INPUT perceived among its clients was substantiated by the research conducted for this study, as shown in Exhibit III-1. The following general comments apply to these responses:

Ex. III-1

  - Information centers, ~~while~~ though conceptually ~~fuzzy~~ vague, are being installed by 70% of ~~the~~ respondents. These vary in implementation from dedicated large-scale mainframes (and appropriate data bases) with full-time training staff, to conduct user education, down to "computer stores" with minimal user support.

  - Prototyping was referred to by some respondents as "interactive systems development" and "eternal systems development", but nonetheless was being used (or planned) by 64% of respondents.

  - Only 17% of respondents stated they had ~~not~~ plans for ~~both~~ neither personal computers ~~and/or~~ nor micro-mainframe links. ~~and~~ It is significant that ~~this~~

~~percentage is the same for both.~~ This indicates ~~Indicating clearly the obvious~~ their intention to integrate intelligent workstations into mainframe-oriented networks. IBM ~~clearly~~ indicated its intention in this regard nearly two years ago when it stated: "IBM PC is communications-oriented--the day of the standalone is over."

o Respondents were also asked for the advantages and disadvantages they associated with the various ~~implementations~~ aspects of the DSD environment. The questions concerning advantages and disadvantages were left open-ended and the responses were categorized. A more detailed analysis of these responses is contained in New Opportunities for Software productivity Improvements, but the results are summarized here to establish the general tone of the DSD environment. The reported advantages are listed in Exhibit III-2. There were few surprises.

Ex. III-2

- Information centers were viewed as a means of educating users concerning data processing (DP) concepts, services and problems (39%); in the use of systems (18%); and in obtaining quick response to user requests (24%).

- Prototyping was felt to have the advantage of getting end users involved (50%) and, significantly, of producing better systems (21%).

- Standalone personal computers were seen ~~as giving the~~ as allowing users "control ~~of~~ their own destinies" (36%), ~~the ability~~ to generate simple reports (16%), to improve ~~user~~ productivity (16%), and to implement ~~provide for~~ cost-effective off-loading of the mainframe.

- Micro-mainframe links were reported to offer the advantage of access to data bases (67%), and to provide for off-loading of the mainframe (17%).

o The reported disadvantages were also ~~rather~~ predictable, but somewhat ~~less centered~~ more diverse than the advantages, which seemed to cluster around the theoretical

and publicized benefits of the particular approach or product. Exhibit III-3 presents the most commonly cited disadvantages. Ex III-3

- Information centers were viewed by IS primarily as requiring additional use of IS resources (35%) and as representing a threat to IS control and standards (10%). However, some vendors and experts expressed two views which are worth mentioning here:

  - It was stated that information centers were IBM's answer to the control of personal computers, and that they were evolving into focal points for the sale of IBM products.

  - There was also the ~~associated~~ related opinion that information centers were an "external diversion to distract the source of unrest" (the IS department itself).

- Prototyping was considered to be wasteful of resources (42%), and it was also felt that users expected too much from the resulting prototype (16%). However, a significant percent (21%) stated there were no disadvantages. In fact, only a few of the miscellaneous responses ~~started to zero in~~ focused on two fundamental problems associated with the general DSD environment:

  - It was stated that prototypes were developed without regard for the quality of supporting data.

  - One user confided that both internal and external auditors were beginning to express concerns about audit trails in an environment where systems seemed to be going through numerous iterations.

- The issue of Standalone personal computers elicited a strong ~~response~~ reaction from IS respondents who felt ~~they~~ the PCs were not integrated with conventional

systems (34%) and that PC use was not being controlled (22%). These was also the disadvantage that their effective use was ~~limited~~ limited by capacity or availability of data (16%).

- Micro-mainframe links were not well understood by IS respondents, but there was a general uneasiness concerning data base problems (26%) and concern that "unreasonable demands" would be made on the mainframe (16%). However, a significant percent rage (21%) stated there were no disadvantages to micro-mainframe links.

o Generally speaking, it can be concluded that IS management is so busy implementing and reacting to the DSD environment that they have not had time to analyze either the advantages or disadvantages of what they are doing. The interviews disclosed a not-so-subtle undertone of letting the users discover the problems of systems development the hard way. However, when attention was directed towards specific, potential problem areas the concern was substantial.

B. THE PROBLEMS IN THE DSD ENVIRONMENT

o IS management was asked to rate certain potential problems in terms of their severity (very serious, somewhat serious, and "no problem"). The severe problems clustered in three areas:

- Distributed data base management as manifested ~~in terms of~~ by problems associated with data base integrity, synchronization, and security/protection.

- Information flow as represented by concerns about conflicting reports to management and about lower systems quality.

- mainframe impact in terms of performance and capacity planning.

o IS management's concerns in these three areas are summarized in Exhibit III-4. More than one-third rated the problem areas "very serious" and less than 20% responded that there were "no problems." The experts' reactions were even more pointed. Here are a few sample comments ~~are as follows~~:

Ex. III-4

- "Problems of security/protection have been talked to death but they have not been addressed on an overall basis."

- "Most programmers and analysts do not have a good understanding of data base management problems...users certainly aren't going to improve the situation."

- "If management ~~recognizes~~ sorts through conflicting information, the problem might get solved--the problem is conflicting action based on conflicting information."

- "Systems quality is going to suffer because you can't separate data problems from systems quality."

- "Information flow, and all of its ramifications, is not understood--period."

C. THE IMPACT OF DSD ON PRODUCTIVITY IN THE SYSTEMS DEVELOPMENT PROCESS

o The major conclusion ~~which was~~ reached in INPUT's multiclient productivity study in 1980, was that an effective productivity improvement program must be built in a logical manner on a firm foundation. The specific steps to be taken, in order of priority, were as follows:

- A commitment to quality is ~~necessary~~ is indispensable to the development of ~~in order to assure that~~ workable, maintainable systems ~~are developed~~. It had to be clearly understood that "quick and dirty solutions" do not achieve acceptable results, and that the life cycle costs for machine time and software maintenance are enormous.

- User ~~lesser~~ involvement in the systems development process is necessary at the earliest stages and throughout actual implementation if unacceptable systems are to be avoided.

- Broad-based management of the systems development function is required in order for business plans to be tightly coupled to IS plans. Top management must understand that the business plan cannot succeed without supporting information; subordinate management must understand how their functions (and information systems) interact with those of others; and information systems management must understand the business objectives being supported.

- Effective personnel must be selected, trained, motivated, and retained. Individual productivity varies tremendously in the information systems function from programmers to IS management. It is not possible to buy "solutions" in terms of people--an effective staff can only be built after the business objectives are clearly understood.

- The appropriate productivity tools and aids can be selected only after all of the above ~~has~~ have been ~~done~~ achieved.

o The approach to building an effective productivity program was depicted in the form of a "productivity pyramid," with "commitment to quality" as the base and "tools and aids" as the capstone, as shown in Exhibit III-5. It is INPUT's opinion that the DSD environment encourages the reconstruction of the productivity pyramid in a highly unstable manner, and has high potential for decreased productivity. The shift in priorities is as follows: Ex. III-5

- User involvement is the name of the game in the DSD environment; it has number one priority and has been moved to the base of the pyramid.

- The right tools and aids have second priority and have been moved ~~next~~ to the position of importance ~~to~~ after that of end-user involvement, where the former capstone forms a balance point for the more important components of a comprehensive productivity improvement program. ~~(In other words~~ In essence, the search for a magic productivity improvement tool means that broad-based management, effective personnel, and quality become dependent upon the tools employed; an this is a precocious balance.~~)~~

- Broad-based management and effective personnel maintain ~~these~~ their relative third and fourth priorities in the DSD environment, but they have become less important than the tools and aids being employed.

- Commitment to quality has been relegated to the lowest priority in the DSD environment, where "results" are all important and quality is virtually ignored until the system has been built.

o INPUT believes that this reconstruction of the productivity pyramid is especially dangerous at this time for the following reasons:

- IBM's highly centralized, host-oriented software strategy as described in <u>Market Impacts of IBM Software Strategies</u> (INPUT, 1984) and its associated performance burden on the mainframe, may mean that the large host systems will not be able to meet the demands of the DSD environment in an economical fashion.

- There is entropy (i.e., tendency toward chaos) associated with data bases and with the communication of information. The DSD environment definitely increases entropy to the point where enormous resources will be

required to maintain (~~much less~~ not to mention improve) the quality of data and management information. Data and information entropy are not currently very well understood, and the probability of systems failure in terms of creating chaos in corporate information flow is quite high. (Data/information entropy was first described by INPUT in a special combined Executive Bulletin for End-User/Corporate Systems, Vol. 2, No. 1 issued early in 1984, and the problem is described in detail in New Opportunities for Software productivity Improvement--the companion of this report.)

- As a dependency upon decision support systems increases and these systems evolve into expert systems, it will become increasingly difficult to identify systems deterrioration. Therefore, it becomes essential to restore commitment to quality to its proper place at the foundation of the productivity pyramid.

o The recommendations to IS management is New Opportunity for Software Productivity Improvement emphasized the restoration of the priorities which were initially established in the productivity pyramid. It was pointed out that there was tremendous need for tools and aids to support quality controlin the DSD environment, but there was no shortage of tools to facilitate implementation of the DSD environment (in fact, the proliferation of tools and aids is part of the problem) under any circumstances, neither the availability nor unavailability of tools and aids should relieve IS management from their responsibility for establishing an effective productivity improvement program--including the intelligent use of available tools and aids.

IV

IV TOOLS AND APPROACHES TO PRODUCTIVITY IMPROVEMENT

A. Fourth Generation Languages ~~FGLS~~: THE KEY TO THE DSD ENVIRONMENT

- Fourth-generation languages ~~(FGLs)~~ have paved the way ~~to~~ for the DSD environment. INPUT's report Trends and Opportunities in Fourth-Generation Languages:

  - Defined ~~FGLs~~ fourth generation languages, their uses and economics, current environment, and impacts.

  - Updated the status of ~~FGLs~~ fourth generation languages, the current and projected products, and the major strategic and tactical issues.

  - Examined market trends and user expectations.

  - Provided market forecasts and recommended vendor strategies.

W.P. - for ~~form now~~ ~~on this~~ the rest of this chapter ONLY, always spell out FGL. as "fourth generation languages"

- The importance of FGLs in the successful implementation of information centers and prototyping was emphasized. The acceptance of microcomputers has been accomplished by corresponding acceptance of, and demand for, enhanced FGLs. The use of FGLs on standalone personal computers has, in turn, created the demand for micro-mainframe links.

o The report predicted that as use of FGLs increases, they will be ~~used for~~ implemented in production systems, including larger systems and transaction-oriented systems. An eventual, and perhaps inevitable role in office automation was also predicted. INPUT forecast that FGLs would be one of the fastest-growing software markets over the next five years.

o This forecast is practically ~~assured~~ confirmed, since FGLs are the key to the DSD environment, and that environment is the most significant trend in information systems. However, to the degree that the DSD environment creates IS problems, and FGLs contribute to the implementation of that environment, FGLs must be analyzed as part of the problem in order to insure their continued acceptance.

o Trends and Opportunities in Fourth-Generation Languages identified two significant is concerns as far as FGLs are concerned:

- The performance characteristics of FGLs require substantial, additional hardware resources. INPUT analyzed the installed MIPS per development person after FGL installation and found an ~~AAGR~~ average annual growth rate of 125% between 1980 and 1983. In other words, hardware capacity to support development personnel increased by an order of magnitude in three years. This is substantially greater than traditional hardware price-performance improvement.

- While there is potential for improved systems quality in the DSD environment, INPUT noted ~~two~~ three basic user concerns:

  • "The most important attributes of quality systems can be addressed by FGLs. What IS sees is the ability of FGLs to improve system robustness, system flexibility, and data integrity."

- "In contrast IS is concerned that users will get carried away with these new-found tools and fail to effectively manage data and information."

- "Another concern is users adding more features and functions and acutually increasing development and operating costs."

o In order to understand the true effectiveness of tools and aids, it is necessary to analyze all impacts of their use. It is also necessary to understand that true productivity exists at several levels. This requires an overview of the DSD environment.

B. PRODUCTIVITY IN THE DSD ENVIRONMENT

o Despite projections of the ~~projected,~~ extended use of FLGs for major information systems, their primary use in the DSD environment has been for reporting and query from data bases. There is no question that FLGs have been effective for this purpose, and they improve productivity in the sense that they produce large quantities of information more rapidly. The question then becomes one of impact on both quality and cost of information.

o It is possible to have an explosive increase in the quantity of information with a corresponding dramatic decrease in information quality. ~~In other words, there is a point where vital information gets lost among the misinformation which is generated in quantity.~~ INPUT uses the term information entropy to designate this natural tedency towards chaos. The DSD environment is a high entropy environment, shown in Exhibit IV-1. ✓ Ex. IV-1

- Data entropy increases as data bases are extracted or developed for use in: information centers ("special" data bases, perhaps for planning), departmental processing centers (distributed data bases), and personal computers (personal data bases).

- The only way to control the natural tendency toward~~s~~ chaos in a high-entropy environment is to apply increasing amounts of "energy" to maintain order. In this case, the energy is computer processing power, plus ~~and~~ human energy to explain the meaning and use of data (data base administrators, information center personnel, etc.) ~~In other words,~~ To the extent that ~~more~~ data bases are distributed, the ~~more~~ "energy" requirements ~~will be~~ placed upon the central facilities will increase.

- Assuming data quality can be maintained at an acceptable level (this is a major assumption, but otherwise quality information would obviously be impossible), there is still no assurance that information quality can be maintained. Every time data are rearranged and/or communicated in the form of information, entropy comes into play again.

  - The FGLs and other "productivity" tools and aids process data and generate different results (information).

  - The people using the data, and tools and aids, use them in a different manner (either through misunderstanding or intentionally.)

  - Data are combined with other data at various levels and definitions become confused or inaccurate.

- As information from these various sources becomes part of the corporate information flow, information entropy increases, regardless of the quality of the underlying data bases.

- The only way to bring any order out of the resulting chaos is to apply more energy. The decision maker must ultimately be the one to select, qualify, and use the information from various sources; otherwise, it is just another exercise in generating additional information and further complicating the decision-making process--~~from~~ the IS department, ad hoc reports from

NP: Make this the last sentence in this ¶

planning data bases, output from prototyped systems at various stages of completing special analysis from specific individuals, etc.

- Therefore, improved productivity in generating more information of lower quality does not necessarily mean improved productivity in terms of meeting corporate objectives. It may be counter-productive in terms of the decision making processes, with disastrous results for the business plan.

o All of the above is an explanation of what "conflicting reports to management" can mean. There are other conflicts in the DSD environment:

- There are conflicts between structured programmi~~m~~ng (and methodologies), principles of top-down ~~desin~~ design and systems which are being developed from the bottom up. There is no assurance that they can be easily integrated.

- Easy access to central data bases is in conflict with the need for protection and security of those data bases.

- As larger systems are developed in the DSD environment with FGLs and other productivity tools and aids, more functional capability will be required. As more function is added, development systems become more difficult to use ~~(less user friendly)~~.

- There is conflict between off-loading host mainframes and the demands for additional central processing power ~~which is being~~ that generated from departmental processors and intelligent workstations. The balance is far from clear, and in the process of trial and error, massive overloads are going to occur in both directions. (Productivity tools and aids ~~which~~ that do not achieve a proper balance are not going to sell.)

- In addition, the parallel GST ~~general systems theory~~ trends of progressive centralization, progressive integration, progressive differentiation, and progressive mechanization (described in Market Impacts of IBM Software Strategies) ~~and~~ are more likely to conflict with each other in the DSD environment. As was pointed out in INPUT's analysis of IBM software strategies, an essential part of IBM's overall strategy is the centralization of GST trends.

o The problems associated with the emerging DSD environment represent opportunities for those who recognize them and so do IBM's attempts to control GST trends. The general market impacts of IBM software strategy must be understood in order to identify promising opportunities. These impacts will be briefly reviewed, but it is recommended that ~~the referenced report~~ Market Impacts of IBM Software Strategies be ~~used~~ referred to for more detailed market analysis.

C. UNDERLYING IBM SOFTWARE STRATEGY

o As mentioned in the introduction to this report, INPUT has defined four IBM strategic software periods, extending past the year 2000. The period between now and 1990 has been called ~~to~~ the SNA/DDP period, and during that period IBM will continue to emphasize the highly centralized host control which has characterized SNA from its inception ~~ten~~ 10 years ago. ~~Follow-on~~ Subsequent periods and IBM emphasis for each are presented in Exhibit IV-2. Ex IV-2

o Recognizing that all of the GST trends progress in parallel, IBM emphasis during any given period determines concentration on particular software categories but does not exclude development in other areas. Keeping that in mind, the strategic periods will be characterized by a focus on particular software areas, shown in Exhibit IV-3. Ex. IV-3

- During the SNA/DDP period, IBM's emphasis will remain upon centralized control--large host processors and large central data bases will continue to dominate the software strategy.

- During the electronic office period, the emphasis will be upon integrating the fourth, fifth, and sixth levels of software (languages/DSS, industry turnkey systems, and applications packages) into electronic office systems.

- During the expert systems period, the emphasis will be upon the differentiation of the integrated electronic systems of the electronic office period into more specialized software (languages/DSS, industry turnkey systems, and applications packages) combined with level seven (data/information/knowledge) through public information networks.

- During the custom products period, hardware, software and data/information/knowledge will be integrated as ~~mechanized into~~ custom products and services tailored to the individual.

o Opportunities exist where IBM emphasis deviates from the GST trend dictated by the current state of hardware and software technologies. For example, FGLs represent a substantial opportunity right now because of IBM emphasis upon centralization and concentration on the first three software levels (SNA, operating systems, and data base systems), and expert systems will have a window of opportunity extending into the 1990s. General vendor opportunities during the SNA/DDP period based on specific deviations of IBM emphasis and GST trends are presented in Exhibit IV-4. ✓ Ex. IV-4

  - During the SNA/DDP period, IBM will remain dependent upon highly centralized software, large processors, central data bases and magnetic disk storage to meet its revenue objectives. The challenges to IBM's strategy are important because they also isolate general areas of exposure and therefore opportunities for competitors:

- Significant use of optical memories could ~~impact~~ affect IBM revenues from magnetic storage, ~~and these~~ revenues ~~are key~~ essential to IBM's growth during the 1980s.

- Offloading of mainframes onto minicomputers has been a threat to IBM's highly centralized mainframe strategy for over ~~ten~~ 10 years, and IBM must continue to control that offloading--even onto their own minicomputers or microprocessors.

- Unless the entropy of large data bases (and that associated with the DSD environment) is understood, IBM's SNA/DDP strategy runs a substantial risk of exposing customers to major systems failures.

- IBM must deliver the large processors required by their strategy, and this may not be as simple as it has been in the past.

- Hardware/software performance ~~(which has~~ never ~~been~~ an IBM strength~~)~~ may prove inadequate to support customer strategies--for example, the increased use of FGLs.

- The success of competing operating systems alternatives have had success (Unix represents one example) at various levels in the processing hierarchy.

- There is a paradox in IBM's SNA/DDP strategy--the emphasis upon centralized control appears more appropriate in the DSD environment thain it has been in the past, but the complex systems software and its ~~resulting~~ attendant ~~associated~~ burden may not be up to the ~~tools~~ task of providing the necessary control.

o INPUT presented a comprehensive analysis of IBM's SNA/DDP strategy in its Large-Scale Systems Directions series of reports during 1984, and reached the conclusion that IBM's mainframes will be used as large data base machines. ~~shown in Exhibit IV-5~~. It is INPUT's opinion that this environment will result in an unprecedented (and unanticipated) demand for MIPS. It is probable that the classic ~~classis~~ solution of throwing processing power at systems problems is reaching the point of diminishing returns (at least on large mainframes). This is an especially important consideration in the development of productivity tools and aids.

- As was pointed out previously, the cost of supporting ~~each~~ system development personnel ~~person~~ (in terms of MIPS) is increasing more rapidly than the processing power per dollar.

- There is a point at which the cost of hardware and software to support development personnel becomes exhorbitant, ~~and~~ just as there is a point at which the cost of the systems developed cannot be economically justified. One expert interviewed during the course of research for this study pointed this out by stating that the increased investment in productivity aids and tools had to be considered in any meaningful measure of productivity.

D. USE AND ACCEPTANCE OF CURRENT TOOLS AND APPROACHES

o Respondents were asked how they felt productivity within the IS department had changed since they were interviewed during INPUT's multiclient study in 1980, ~~and the changes which~~ ~~that~~ ~~had been initiated that~~ and what they felt had prompted these changes. The responses are presented in Exhibit IV-5. Ex IV-5

- The changes in productivity since 1980 were reported as follows: 37% stated productivity had improved substantially, 37% stated it had

improved "some", 14% said it has remained the same, 6% reported it had decreased, and 6% reported a substantial decrease in productivity.

- The changes which prompted productivity improvement were ~~as follows.~~ :

  - Thirty-nine percent attributed the improvement to the installation of terminals to permit interactive development.

  - Thirteen percent reported that the improvement had resulted from the use of FGLs.

  - The remaining 48% of respondents mentioned specific tools or approaches which varied from a specific package such as IBM's

Interactive Systems Productivity Facility ISPF to "better planning."

- Where productivity decreased it was attributed primarily to "aging" and overloaded systems, and such structural changes as reorganization and acquisitions.

o Respondents were also asked about their current use of systems design methodologies and their specific use and evaluation of programming aids.

- Seventy percent of those responding stated they employed a system design methodology (SDM) and 68% of those using an SDM had developed their own. Eighty-six percent of those using an SDM felt that it has improved the systems development process.

- Seventy-seven percent of those responding stated they emphasized programming aids; and when asked which ones, over fifty products were mentioned with few products receiving more than a single mention. Seventy-five percent of the respondents using programming aids felt they were effective.

o This simple research revealed the truth of the matter--there ~~are~~ is a wide array of effective productivity tools and aids available, and ~~where~~ if an approach (such as an SDM) is useful it will be used--even if the users feel they should develop their own. During the course of desk research for this study, a productivity questionnaire developed by Cap~~us~~ers Jones was discovered. It consisted of:

- Twenty major sections and 261 categories under those sections.
- Under the code development section there were 14 categories:
  - High-speed prototyping.
  - internal reusable code library.
  - Commercial reusable code tools.
  - Structured coding methods.
  - Applications or program generators.
  - Fourth-generation languages.
  - Data base query languages.
  - Standard functional packages.
  - Spreadsheet processors.
  - Information centers.
  - Development centers.

- Object-oriented languages.

- End-user programming support groups.

- Individual terminals or workstations.

- Twenty years ago, Fred Brooks (of "Mythical Man-Month" fame) stated after becoming Director of Programming Systems for IBM: "I think we have more terms than concepts." The situation has not improved since then. Users are confronted with a formidable array of ill-defined choices.

- As far as the code development market is concerned, there are currently over 100 spreadsheet processors (or integrated analysis systems) which contain spreadsheets available to end users, and it is estimated that 15 to 20 new products per year are being announced in the FGL category alone. ~~If~~ Though the market is chaotic, the potential customers remain undaunted, ~~they are still~~ in their ~~looking~~ search for ~~some~~ a solution to the productivity problem.

o ~~The~~ IS directors were asked whether they were ~~currently~~ more or less ~~or less~~ receptive to possible alternative productivity approaches than they ~~were~~ had been in 1980. The results are presented in Exhibit IV-6. ✓ Ex IV-6

- The increased acceptance of FGLs is clear: 79% of respondents are more receptive to ~~these~~ their use than they were in 1980, and no respondent was less receptive. It is INPUT's opinion that the DSD environment is fueling this increased acceptance of, and demand for, FGLs.

- There is also an increased acceptance of applications packages (61% of respondents are more receptive) as an alternative to in-house development.

- ~~With~~ Concerning industry turnkey systems, 41% of respondents are more receptive, as opposed to only 15% being less receptive.

- ~~With~~ Concerning outside systems and programming assistance, the balance shifts — with 43% of respondents being less receptive to such services and only 25% being more receptive.

- As anticipated, outside processing services are re~~viewed~~ceived with substantially less favor. Fifty-nine percent of respondents stated they were less receptive than they ~~were~~ had been in 1980, and only 11% stated they were more receptive. (This question was not designed to ~~beat a~~ hammer at a dead ~~horse~~ issue; it is highly probable that some categories of expert systems will be delivered as a remote service from proprietary knowledge bases and inference engines.)

WP: subsub

E. I.S. MANAGEMENT'S DILEMMA SUMMARIZED

o Microprocessor technology combined with user friendly software has created the DSD environment. In this environment, it is possible to see tangible results much more rapidly than through the conventional systems development process. End users become involved in the systems development process with the following results:

  - They cannot understand why it takes so long for the IS department to develop systems.

  - They become more "expert" than the IS department in some of the new technology.

  - Additional demands are made upon the IS department to support and employ the new hardware/software systems.

- There ~~are~~ is an astonishing array of hardware/software "solutions" available in the DSD environment, but ~~The~~ the IS department ~~is~~ are not necessarily expert (or even literate) in the use of these tools, aids and/or technologies. The natural tendency is to become defensive (the COBOL vs. FGL controversy is a good example) and to seek direction and support from its traditional ally--IBM.

- Unfortunately for the IS department, IBM is not only offering ~~multipled~~ various (and conflicting) solutions of its own, but also is endorsing the products of other vendors who would formerly have been considered competitors. This endorsement can take many forms, ranging from outright acquisition (ROLM) and substantial investment (INTEL) ~~down through~~ to marketing agreements (INTELLECT from Artificial Intelligence, Inc.).

- It all adds up to substantial confusion as to exactly what IBM is doing, or will do in the future. This ~~impacts~~ affects not only competitors but also customers who may be looking for some direction and have learned over the years to trust IBM. In the DSD environment more than trust is required--IBM seems to be demanding blind faith.

- IBM's reputation is such that many companies (or at least their IS departments) are willing to believe that anything IBM endorse~~d~~s will "turn out all right" because IBM "will make it work". While this belief is not entirely unjustified, some of the more informed IS managers are becoming concerned about ~~some~~ questions which IBM has never been especially interested in solving for their customers. Specifically:

    - Whether the cost of "making it work" is worth it.

    - Whether the necessary data to support the hardware/software systems is available, or of sufficient quality, to warrant the investment.

- Whether management will consider the investment in computer hardware/software systems to be justified based on the quality of the ~~output~~ (information) produced.

o However, most IS management is so busy reacting to the new DSD environment that they have not had time to consider even the tools and aids which might be useful ~~to make~~ in making the IS department more effective, much less the quality of the systems they are so busy implementing; and now ~~the~~ IS departments have a vague sense of impending doom.

IV

V NEW OR IMPROVED TOOLS REQUIRED

A. RESEARCH CONCLUSIONS

- Most IS managers responsible for supporting the DSD environment do not have sufficient knowledge ~~of~~ or resources to evaluate the tools, aids, and approaches to productivity improvement which are currently associated with that environment. When asked about tools, aids and approaches which might facilitate the implementation of the DSD environment, very little specific direction was evident from the responses, as shown in Exhibit V-1. ✓ Ex. V-1

    - Education included everything from better product education ~~from~~ by vendors ~~down~~ to general user education on data processing concepts and problems.

    - Networking elicited a ~~was~~ similarly vague response except that micro-mainframe links were mentioned frequently; however, neither IS management nor vendors have a very clear concept of ~~exactly~~ what is meant by a micro-mainframe link~~s~~.

    - The answers falling into the "other" category varied from the very specific (RACF and SAS Graphics) to the extremely vague ("better prototyping" and "decision support software").

o The anticipated problems associated with the DSD environment ~~were~~ had been identified in the interview prior to the ~~time the~~ respondents ~~were~~ being asked for their recommendations ~~or~~ of tools, aids and approaches to control the DSD environment. The responses indicate that very little thought has been given to solutions to the problems which were so easily identified. (See Exhibit V-2.) ✓ Ex.V-2

- Twenty percent of the respondents failed to answer the question at all, and an additional 17% ~~specified~~ specifically stated they had not given the matter any thought or didn't know what was required.

- The only "solution" that was suggested by a significant number of the interviewers (17%) was ~~the~~ "To limit data base access." This solution has high potential for being in direct conflict with the primary purpose of micro-mainframe links, which is to provide access to central data bases. In fact, one of the experts interviewed cited a particular example where a major bank encouraged distributed processing (and distributed systems development) with the following results:

  - The various organizational entities within the bank soon recognized that data/information represented power.

  - Therefore each organization attempted to acquire data from the others but ~~more~~ none wanted to provide access to ~~these~~ their own data bases.

  - The result was an environment in which a number of ~~warring~~ warring data-based fiefdoms competed against each other for management's attention, with disastrous results for the institution (and eventual return to a centralized IS operation~~s~~).

- There is an area of agreement in the responses, in that education is mentioned as being necessary for both ~~facilitating~~ promoting and controlling the DSD environment (17% mentioned education ~~under facilitating~~ for promotion and 10% ~~under~~ for controlling~~)~~. It is assumed that these responses reflect a general

feeling that if the limitation of the tools, aids and approaches being employed in implementing the DSD environment are understood the problems will not develop. It is INPUT's opinion that this is not necessarily so because the problems are not currently understood. ~~In other words,~~ even with intelligent implementation, unpleasant surprises will arise unless the threats to information quality are recognized.

- The "other" category contained ~~a miscellaneous~~ an assortment of requirements such as: standards, capacity planning, data dictionary, back-up facility for data integrity, and structured project management. ~~etc. In other words, a variety of means of addressing parts of the problems which had been identified.~~

o When asked whether they had heard about any new tools, aids and approaches which seemed promising for the DSD environment, 60% of the IS respondents stated "no", 17% did not respond, 7% stated they hadn't looked, 7% mentioned IBM products (RACF and DB2), and the remainder (8%) mentioned several other specific packages. This general lack of responsiveness to an extremely dynamic market ~~in terms of new product announcements~~ can be interpreted in several ways:

- Anything "new" runs a high risks of being lost among the abundance of tools, aids, and approaches already available.

- IS management does not have the time and/or ability to analyze ~~(understand)~~ the tools, aids and approaches ~~which~~ that might improve productivity in their organizations.

- Nothing new is really being announced; all of the activity represents a repackaging of past solutions with new terminology.

- It is probable that all of the above are at least partially true, and the result is chaos in the marketplace. One thing is certain in such an

environment--there is no certainty that ~~one~~ those who build~~s~~ a better mousetrap will have anyone beating a path to ~~his or her~~ their door.

- o Vendors and experts generally paralleled IS management in their recognition of the potential problems associated with the DSD environment. However, ~~depending upon~~ apart from ~~their~~ each's particular ~~orientation towards~~ approach to solving the productivity problem, they generally chose to ignore their contribution to the overall problem of systems quality. ~~In other words,~~ Users of the tools, aids and approaches were ~~assumed~~ expected to make intelligent use of the products and were handed ~~given~~ responsibility for understanding (and correcting) any impacts on systems quality.

  While this general attitude is understandable, and even justified, INPUT believes that a substantial opportunity exists for those vendors ~~who~~ that are willing to address ~~the~~ quality problems ~~in a~~ direct~~ manner~~ly.

- o In summary, the current emphasis upon end~~-~~user involvement in the systems development process, without sufficient attention to quality, has created an environment ~~(which INPUT calls DSD)~~ that IS management recognizes as presenting some serious problems. However:

  - These potential problems are not very well understood, and are generally being ignored in the rush to implement the DSD environment.

  - Current productivity tools are available in abundance, but may result in the rapid development of systems of such poor quality that they will actually be counter~~-~~productive.

  - The need to complement and supplement current productivity tools, aids, and approaches with facilities to maintain and improve information quality is generally recognized.

  - IS management is currently unable to define specifically their requirements for features and facilities which would be of value to them in controlling the DSD environment.

- Classic market research techniques are of little value in defining market requirements and opportunities in an environment ~~which~~ that is as complex as that ~~which has been~~ described in this study.

- ~~It is concluded that some~~ New methods of market analysis and forecasting are required if the substantial opportunities presented by the DSD environment are to be ~~identified~~ exploited. ~~Fortunately,~~ A general framework for both market analysis and forecasting ~~was~~ has been presented by INPUT in <u>Market Impacts of IBM Software Strategies</u>, ~~INPUT~~ 1984.

B. WHAT IS AN INFORMATION SYSTEM?

o It is ~~rather~~ important to understand exactly what an information system is, and the current status of the hardware/software technology needed to support such systems, before determining how such systems can be most effectively implemented.

- The first thing to recognize is that information systems existed before computers, and consist of only five primary processes: input, communications, calculations/manipulation (processing), storage, and output. The most important thing ~~is that is~~ happening in information systems development is the change from paper to electronic media, as shown in Exhibit V-3. Ex. V-3

  - The historical information is presented only for perspective. The mechanical ~~(and electro-mechanical)~~ and electromechanical devices of the ~~1800s~~ 19th century (cash registers, adding machines, punch card equipment, and typewriters) have been severely impacted by electronic counterparts. However, the telephone and telegraph remain virtually unchanged in terms of function~~s~~ (despite electronic implementations).

  - However, at this point, only the calculation/manipulation process is currently ~~predominantly~~ electronic rather than paper-oriented. Very

few paper and pencil calculations are performed, and mathematical tables ~~have~~ are effectively ~~been~~ obsolete~~d~~.

- ~~The~~ other processes rem~~ai~~n predominantly paper-oriented.

  - Paper reports and records of transactions remain the primary source of entry into both information flow and computer data bases despite the development of some major operational systems ~~which~~ that capture data at its source. (For example, airlines reservation systems and a limited subset of financial transactions such as ATM's.)

  - Paper remains the primary communicat~~io~~ns medium between individuals and systems (including processes within systems--output to input and output to storage, ~~etc.~~)

  - Despite rapid~~ally~~ly increasing use of magnetic storage and micrographic storage most information resides in paper libraries and file cabinets, and the volume of paper documents requiring storage (or disposal) continues to grow at an alarming rate.

  - As ~~for an~~ Far as output ~~in~~ is concerned, it is not ~~unfair~~ inaccurate to state that the ~~application~~ implementation of computer technology and office automation products has increased the amount of paper output astronomically~~, and then, in turn, has~~ creat~~ed~~ing the current productivity problems ~~among~~ in white-collar workers ~~in general~~.

- It is, therefore, of extreme significance that technology to control this paper glut is becoming available. ~~Specifically,~~ It is INPUT's opinion, that the availability of cheap, optical storage is key to ~~less~~ a reduction in paper ~~in~~ for their information systems, as opposed to paperless offices which will require reorientation of the entire work force. (It is beyond the scope of this study to pursue the development of optical memories, but readers of

this report are encouraged to review Impact of Upcoming Optical Memory Systems, INPUT, April 1983.)

- The important conclusion is that the substitution of electronic for paper media (in the fundamental information system processes) represents the primary design point for the systems ~~which~~ that will be developed during the late 1980s and 1990s. This has many ramifications for IS management and thus for vendors.

  - Understanding and becoming involved in current paper-based information systems and procedures becomes imperative for IS management.

  - The quality impacts of the DSD environment on information flow, as depicted in Exhibit IV-1, become ~~of~~ increasingly important as the replacement of paper-based systems and procedures becomes imminent, and IS management faces its responsibility ~~for~~ in facilitating this replacement. ~~In other words,~~ When ~~those~~ conflicting paper reports ~~(from whatever source)~~ must be replaced, they must be ~~reconsidered,~~ integrated ~~and~~ and debugged, and there isn't any question about who ~~is~~ was ~~going to be~~ responsible for ~~1)~~ letting it happen, ~~and 2)~~ nor about who will straighten~~ing~~ out the mess ~~out~~.

  - The tools, aids, and approaches IS management is going to need ~~are going to become~~ will be apparent only after current information flow is clearly understood and the impact of new hardware/software technology is fully appreciated.

- The DSD environment is designed to improve productivity ~~in the sense of being able to~~ by providing quick answers to specific requests for information, typically in ad hoc reporting, special analyses, and "what if" queries. To the degree that the quality of information systems is impacted by this environment, the most likely questions from management will probably change to ~~"why?"~~ "why?":

(Ref. Ex. IV-1)

- Why don't these reports agree?

- Why does this information cost so much?

- Why is this information wrong?

- Why isn't the data base any good?

- Why do we need a bigger computer?

- Why do we get different answers to the same question?

o - These questions will be substantially more difficult to answer than were the original requests for information, and they will have a severe impact on both the productivity and the credibility of the IS function.

o Therefore, while IS management may not be able to specify the tools, aids and approaches they require in order to improve productivity, it is possible to formulate requirements by anticipating the hardware/software technological environment, the types of information systems which will be possible, and the problems which will be inherent in the development of these systems.

C. PRODUCTIVITY TOOLS AND AIDS IN THE DSD ENVIRONMENT

o It is ~~obviously~~ beyond the scope of this study to specify new tools and aids for productivity in detail. Some may appear to be currenly available; ~~and~~ others may be merely a research direction to determine the best solution to a problem. However, they are all directed towards restoring commitment to quality to its proper place in the productivity pyramid. In addition, these tools and aids have two additional attractions:

- They are especially well-suited for providing not only control in the DSD environment, but also necessary data and information to develop systems requirements and specifications for the electronic office (office automation system).

- They will establish the foundation for ~~extending~~ decision support systems ~~to~~ expert systems (where quality must be fundamental) by providing at least a preliminary connection between data/information bases and the decision-making process. By tracking data/information flow and associating it with use in decision making potential for expert systems may be identified, and at least some of the inputs to future knowledge bases will be qualified. The developers of expert systems have already determined that they must be prepared to answer "why?" questions. Understanding what any system is doing is fundamental, ~~the~~ To quality control and improvement, and expert systems will require rigid and continuing quality contol.

I. ~~AN~~ INFORMATION BASE MANAGEMENT SYSTEMS (IBMS)

New Opportunities for Software Productivity

INPUT's Information Systems Program

o ~~The ISP~~ companion to this report (~~U-SSP~~) identified the need for an "expanded data/information dictionary capability" as an aid to productivity improvement. Actually, as the requirements became more clearly understood, it was apparent that, even in it's simplest form, the system required was much more comprehensive than any extension of a current data dictionary. For lack of a better term, INPUT ~~has~~ calls ~~the~~ this system an Information Base Management System (IBMS). Essentially, it is a central locater of information sources, and can most easily be described as a supervisory system for other data/information dictionaries and directories.

o The complexity of the system ~~arises~~ becomes apparent as soon as it is recognized that human beings and organizations are information sources, as ~~well as~~ are data bases, libraries and file cabinets. A rough diagram reveals the comprehensive nature of such a system, as shown in Exhibit V-4.

Ex. V-4

- In its simplest implementation, the IBMS could merely provide centrol access to various catalogues, directories, and dictionaries.

- Search and retrieval capability against these catalogues, directories, and dictionaries could be enhanced by prompting, to refine inquiries (and reduce information references).

- More detailed vertical penetration would permit rapid browsing. For example, abstracts and descriptions could be prescanned and surrogate data bases developed (~~essentially~~ key words are extracted) for fast searching. The bottom of the vertical chains would always provide specific access information and detailed descriptions and definitions of what is being accessed. This could be instructive in how to use a data base system or a telephone number of a specific person.

- In addition, the software programs used and/or available to develop information from data would be available. ~~In other words the tools and aids would be classified and retrieved based on the information desired.~~

o Ultimately, the ability to associate and compare qualify the various information sources ~~with each other~~ in a meaningful domain for research and analysis on a specific project (subject) would be the goal of IBMS. This would have the following ramifications:

- It would be an "expert system" in the sense that it would not search based on specified algorithms and would present a preliminary knowledge base rather than a list of information sources. (This significance of expert systems will be presented in INPUT's ~~planned~~ report on Artificial Intelligence and Expert Systems.)

- The ability to locate, qualify, and associate various information sources during the requirements phase of the systems life cycle would be an extremely effective productivity tool. Specifically:

- Redundant information systems would not be developed where adequate information already existed.

- Software systems unsupported by necessary data/information could ~~hopefully~~ be avoided.

- Indeed, in certain decision support situations the query might provide all necessary information. ~~(The IBMS~~ should be viewed as a shared resource among the IS department, information centers, and end users.)

- Since the quality of data and information are fundamental to systems quality, the IBMS is a necessary quality control mechanism, and

o The development of an efficient IBMS obviously requires a great deal of effort (and perhaps invention) on the part of systems software developers and information specialists (librarians, data base administrators, etc.) However, it has the advantage of being modular and lends itself to phased implementation. Essentially, it is a ~~shell~~ mechanism to facilitate integration of existing systems (manual and computer-based ~~is all that is required initially.)~~

2. ~~A~~ DOCUMENT CONTROL SYSTEMS (DOCS) stet

o ~~Perpahs~~ Perhaps the most important missing subsystem under the IBMS is a comprehensive document control system (DOCS). Most organizations have automated portions of the process (mailing lists, classified documents, engineering drawings, etc.), but IS departments have ~~normally~~ traditionally ignored paper-based systems and procedures until there are demands for computer-based systems. In addition, the paper mill mentality of data processing personnel has contributed to the problem by facilitating the production of paper reports.

o Information entropy in the DSD environment as identified in ~~their~~ this report (see ~~as shown in~~ Exhibit IV-1) and the potential for controlling and/or eliminating

(Ref Ex. IV-1)

paper documents in the electronic office strategic period (see Market Impact of IBM Software Strategies) both offer compelling reasons for the development of a comprehensive DOCS.

o The DOCS ~~system~~ should provide for the following:

- Distribution control, perhaps enforced by requiring all forwarding of documents to ~~be addressed through~~ handled by a central directory.

- Classification, not only for security purposes, but for information quality. ~~For example:~~ Classification could be

  . Produced from a certified central data base by production programs.

  . Produced from a certified central data base by prototype system.

  . Produced from a control data base extract by a specific personal computer software package.

  . Produced from a personal or organizational data base by registered program (tested and installed centrally).

  . Produced from a personal data base by special program.

  The variety of categories is enormous and ~~obviously~~ must be tailored to the organization's requirements, but the restriction of classification provides a means of ~~lowering~~ reducing information entropy.

- Footnoting, in order to associate the specific document with other information branches under the IBMS. This could be selectively printed on the document or available upon request.

- Retention information, pertaining to the storage, retrieval, and disposal of the document (either paper or electronic).

o The DOCS ~~system~~ is ~~obviously~~ essential as ~~so~~ more documents become ~~are~~ stored on magnetic and/or optical media, but it also should provide the means for data and information flow analysis, which is so essential in the DSD environment.

The work required to implement such a system is considerable, ~~and~~ the need for imaginative tools and aids is limited only by the creativity of those addressing the problem. Once the DOCS structure has been established, the need for more refined analysis tools and control mechanisms will become apparent.

3. DATA FLOW MONITORS (DFM)

o At ~~the~~ present ~~time,~~ there is a tendency to down load data to microprocessors in report format, and it is possible that with a fully developed DOCS, data flow could be monitored by merely associating the document with the data base broach of IBMS, as shown in Exhibit V-3. However, since data will be distributed both through reports and through direct requests for data transfer, and it is anticipated that some of these requests will be "unreasonable". Ref. Ex. V-3

o Data flow among systems and intelligent workstations must be monitored to determine performance (and cost) impact on the communication network, host systems, processing nodes, and intelligent workstations. A host-controlled data flow monitor (DFM) will be essential if a proper distribution of both data and processing is ~~are~~ to be maintained.

o DFM becomes activated at the point where data/information is to be ~~actually~~ transferred from or among systems (host or development processors) and/or intelligent workstations ~~(in other words~~ after the data/information has been located, using IBMS). However, since the request for location information must be monitored, DFM treats IBMS as simply another query system to be monitored, as shown in Exhibit V-5. Ex. V-5

o The purpose of the DFM ~~would be~~ is to analyze authorized requests for data/information (protection and security will be isolated in a separate systems) either upon request or in anticipation of network performance problems, and to accumulate data/information flow statistics for analysis. Implementation of a DMF could vary from the very simple to the extremely complex.

- Simple decision rules could screen out impossible requests, ~~or~~ for example, you don't send a gigibyte data base to an intelligent workstation even if the requester is authorized to access the entire data base because it might be physically impossible.

- Either the central processing required or the communications capacity required might be considered cause to reject a request based on anticipated impact. For example, performing a JOIN on relational tables beyond a certain size might be prohibitied (in fact, building relational tables beyond a certain size might be prohibited), or single requests for data/information might be screened based on the capacity of the communications link.

- A further level of refinement might anticipate an error (or naive request) on the part of the requestor based on the volume or cost of the data/information requested.

- The statistics gathered by DFM are for use in both refining the protection/security system and in permitting management analysis for information flow and organizational studies. The ~~level~~ type of statistics gathered could be geared to various levels from micro-organizational levels down to the individual.

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- In addition, the statistics would be essential for network planning and control. ~~In other words,~~ the network configuration directory is really a

model of the total hardware/software network which is subject to operational analysis for purposes of reconfiguration.

o The purpose of the DFM ~~are~~ is to ~~assure~~ ensure that unworkable (or unnecessary) systems do not evolve in the DSD environment. Conventional hardware and software performance monitors and accounting systems will be essential in implementing DFM, but ~~now~~ new tools are also necessary. Some tools are beginning to emerge in work which is being done in artificial intelligence, and some are already available in the more pragmatic work which has been done in operations research. However, there is no question that creative adaptation and even invention are required for quality control in the DSD environment, which truly represents both challenge and opportunity.

4. OPERATI~~NG~~ONS RESERACH AND ARTIFICIAL INTELLIGENCE (OR AND AI)

o There is a ~~storage and almost eerie~~ strange connection between operations research, artificial intelligence, and security/protection ~~which threads it way~~ that can be traced back to Great Britian during World War II and specifically to Alan Turing.

- The famous Turning test is still ~~said~~ used as a measure of machine intelligence, and becomes especially appropriate in complex computer/communications environments.

- The term "operations research" was developed in ~~combatting~~ the course of fighting German U-boats in the North Atlantic.

- ~~And~~ Turning was a key figure in developing the hardware necessary to break the German "Enigma" codes and ~~consequently~~ thus to "read the mail" of the German communications network. No where was this more effective than in combatting German naval operations.

o Since World War II operations reserach has taken a rather pragmatic approach to many problems associated with industrial engineering; artificial

intelligence ~~(until recently)~~ became an academic research area; and security/protection has become a matter of substantial concern associated with both private and public data bases. It is only in the current environment of emerging expert systems that the connection between operations research and artificial intelligence is being established (or at least considered). Specifically:

- The break between algorithmic and inference-based solutions to complex problems has resulted in an "either/or" mentality, which appears to be reaching a point at which it could be detrimental to both disciplines. The better-informed practioners (on both sides) are beginning to understand the need for communication between OR and AI, but it is probable that the rift will result in serious problems with some early expert systems.

- The important point is that elaborate expert systems of questionable value may be developed where the proper application of existing tools of operations research would provide better solutions; and/or, the tools of operations research will freeze "solutions" to problems which could benefit from the analysis and flexibility inherent ~~interest~~ in the ~~development of~~ knowledge-based and expert systems.

- It appears that even DFM will require the proper application of tools from both OR and AI; and in fact, application of OR and AI tools may in themselves require a DFM.

o There has been a ~~an~~ gradual (and sometimes reluctant ~~begruding~~) recognition that the work done by OR researchers on queuing networks has value for ~~application in~~ resource allocation (performance monitoring) of both operating systems and computer/communications networks. One of the problems of acceptance was that the example that OR researchers used for queuing networks was a highway with multiple on & ~~and~~ off ramps ~~(how pragmatic can you get)~~ and the problem of a CPU with multiple I/O devices was not readily apparent to computer

scientists. Currently, application of queueing network theory to local area networks (LANs) is becoming apparent.

o A general analysis of queueing networks was contained in What Can Be Automated? (The Computer Science and Engineering Research Study, MIT Press, 1980), and a portion is quoted here because it has significance for the OR/AI interfacing problems ~~which~~ that INPUT anticipates:

- "There has been remarkable agreement whenever networks are used to predict device utilizations and throughputs; errors seldom exceed 5%. Network models are less reliable as predictors of queue length and waiting time; but even then, an error rate of less than 25% is common. This agreement is even more remarkable when we realize that the queueing theory seems to rely on the assumption of exponential service-time distributions in each system device, something that rarely happens in practice. The success of research in these models leads us to the conclusion that it is better to use a model whose structure is accurate and whose service-time distributions are approximate than to use a model whose structure is approximate and whose service distributions are accurate. In other words, more error ~~are~~ is introduced by approximations in the structure of the models than is introduced in the distributions.

- Under any circumstances, it is INPUT's opinion that the application of queueing network theory can make a substantial contribution to many of the functions associated with the DFM and it has been incorporated in the monitor's structure, as shown in Exhibit V-~~4~~5. Ex. Ref V-5

o On the other hand, problems of entropy in both data and information are not clearly understood ~~as shown in~~ see Exhibit VI-1, ~~expect~~ except to state that: Ref, EX IV-1

- Entropy is higher on large, flexible data bases, and it is assumed that more processing power (energy) is required to maintain quality. For

example, it is apparent that a large data base employing the relational model has high entropy.

- Rearrangement of the same data in many different formats (distribution of data bases) increases entropy.

- Distribution of the same information in many forms increases entropy.

- The more ~~modes~~ nodes (whether hardware, software, or human) that data/information flow through in a communications network, the higher the entropy of the network.

- To the best of our knowledge, effective models to measure data/information entropy do not ~~currently~~ exist. There ~~are~~ is a ~~needs~~ need for analysis and control mechanisms at all levels ~~in~~ of data/information networks. Research is required in many areas before practical tools can be developed to address all of the problems of entropy, but some progress can be made with better ~~and expanded~~ knowledge of information theory. Giving focus to the problem by establishing even the most rudimentary analysis tools to measure entropy is essential, and this would be an objective of the DFM. ~~as shown in Exhibit V-4.~~

o ~~It also occurs to~~ INPUT recognizes that workable information systems networks are being designed by "experts" who intuitively know that you don't dump massive reports on top management ~~, and you don't~~ or filter essential operational information through excessive levels of management and expect to have effective decision-making at the top. There is a need to extend decision support systems to knowledge-based systems, and if this is to be done it must be done with an understanding of data/information entropy. The productivity tools and aids mentioned thus ~~face~~ far (IBM, DOCS, and DMF) are all designed to contribute to the general knowledge base from which specific expert systems can be developed.

o There is an important paradox in all that has been described above; the tools of OR and AI appear to be essential in developing tools and aids to control quality in the DSD environment. However, the very OR and AI tools required may result in quality control problems of their own; especially in the area of performance. Hans J. Bremermann in his paper on "Complexity and Transcomputability" (The Encyclopedia of Ignorance, Pergamon Press, Ltd. 1977) points out that both operations research and artificial intelligence frequently require computational algorithms (OR) and searches through exponentially increasing alternatives (AI) which exceed the capacity of any computing resource on earth. In fact some OR and AI "solutions" can easily exceed the capacity of any computer which can even be built, and this is referred to as being transcomputable. Bremermann describes the problem as follows:

- "We call an algorithm transcomputable if its computational cost exceeds all bounds that govern physical implementation of algorithms.

- "It can be shown that the exhaustive search algorithms for chess is transcomputable. The same is true of many algorithms of artificial intelligence and operations reserach. In fact, any algorithm whose computational cost grows exponentially with a size parameter n is transcomputable for all but the first few integers of n.

- "This is a rather disturbing thought and many prople have chosen to ignore it."

o Therefore, the only advice which seems appropriate when developing necessary quality control tools and aids which employ OR and AI is to proceed with caution, but by all means proceed.

5. SECURITY, PROTECTION, AND PRIVACY (SPP)

- Everyone knows that security and protection of both public and private data bases present problems which will only be compounded in the DSD environment. Any system which is developed without proper attention to these problems runs a high risk of either being inoperable or subject to replacement. It is INPUT's opinion that even isolated cases of harassment of private citizens will soon lead to increased attention to the question of privacy, and this has additional ramifications:

    - There is the obvious potential for law suits, which will lead to the requirement for some type of guarantee that data bases are secure.

    - Privacy legislation requiring that access information be made available upon request will become more common, and requests for such information by individuals will increase. This will have substantial impact in several areas:

        . It will require a computer-based access and control system for paper-based files (similar to DOCS), and will accelerate ~~give impetus to the~~ conversion to the electronic office.

        . Most current data base systems will not be adequate to ~~in~~ supply~~ing~~ required access information, and will have to be either replaced or enhanced.

        . Many current public data base services may be severely impacted.

        . There will be substantial opportunities for expanded security, protection, and privacy hardware/software systems.

o The SPP problems associated with distributed data bases and information flow have been anticipated and substantial research has been done. However, ~~over~~ even rudimentary SPP facilities are not currently being provided in most commercially available systems, and are certainly not being incorporated in most systems being developed in-house. The SPP problem is increasing in complexity exponentially and even the linear advances in solutions are not being applied.

o Security hardware/software is going to be a big business for those who understand the problem and can provide even partial solutions ~~which~~ that will extend the life of current systems, ~~and at least~~ but this field contains at least as many ~~the~~ problems as are anticipated in the DSD environment. More important, DBMS's and micro-mainframe links which do not provide at least state-of-the-art SPP facilities are not going to find a ready market. STET hyphens.

o While it is beyond the scope of this report to even address the current state-of-the-art in SPP (much less to present a solution), there are several important structural considerations which become apparent in the DSD environment: wp: delete them here

- SSP in the DSD environment should preferrably be separated (isolated) from the various subsystems. For example, a central SSP module should serve IBMS, DOCS, and various DBMS's ~~which~~ that operate in a distributed data base environment. This means a centralized system for paper documents, encoded data bases, and even voice messages.

- While specific data base (or operating) systems might continue to incorporate their own SSP systems and procedures (for example, on a local area network), the quality of these specific systems would be a controlling factor in the distribution of data/information. In other words, the SSP facilities incorporated in a DBMS (perhaps DB2) or and operating system (perhaps Unix) could be a limiting factor in the distribution of data from a host system.

- SSP facilities should be as automatic as possible in the DSD environment. This ~~emphasis~~ implies centrally controlled encryption and management of access codes and keys. For example, keys and codes could be dynamic, based on the preference of the local organization or individual. This would permit multilevel and random security interrogation from the central source if that ~~was~~ were specified by the user. ~~In other words,~~ The user would thus be left with responsibility for establishing the level of security he deemed necessary, but implementation would be relatively automatic.

- The complex security problems of information flow in the DSD environment, while not readily solvable by known techniques, are best addressed for purposes of study and research by a central SSP in conjunction with the facilities of the DFM.

6. LANGUAGES

o It should by now be apparent that languages, whether they are classifed as first, second, third, or fourth generations, are going to proliferate. However, these designations are ~~currently fuzzy~~ vague at best and INPUT, rather than adopt the standard ~~nomenclature~~ designation of 4GL (for fourth generation languages), uses FGL (for fourth, fifth or future generation languages). ~~In other words,~~ Languages are evolving, and whether natural languages or icons prevail is not the question--there ~~are~~ is going to be a whole range of languages at the user interface, and this will become apparent in the electronic office.

o An ~~real~~ aid to both productivity and the implementation of the quality control tools and aids which have been described above would be a "metalanguage" which would incorporate the following:

- A standard representation for various FGLs (~~in~~ INPUT's ~~sense~~ definition) which would facilitate:

- Communications ~~between and~~ among various systems and intelligent workstations, ~~as well as~~

- The development of new languages at the user interface.

- The metalanguage would also describe communications and operating systems command languages in ~~a~~ standard fashion to assist in tracking data/information flow, and would facilitate the implementation of ~~the~~ quality control tools, especially in the performance area.

- The distribution of development activities to information centers and intelligent workstations could be enhanced to include all language interpretation (by ~~into~~ the metalanguage), and provide a single language for the receiving system (whether host or distributed system.)

o INPUT believes host systems are becoming either large data base machines or heavy number crunchers. If ~~we assume that~~ the relational model of data ~~will~~ becomes prominent in the DSD environment (and in ~~for~~ expert systems), ~~this means that~~ large systems will be dealing with arrays (for heavy computation) and tables (if relational data bases). This leads INPUT to project that future large-scale system architectures (after Sierra) will reflect this requirement. For that reason, it would appear that this should be considered in the selection of a metalanguage. Without a great deal of analysis, the time may be right to consider APL (A Programming Language).

VI

VI MARKET ANALYSIS AND FORECAST

A. MARKET ANALYSIS

- Gross market forecasts for either hardware or software products are meaningless without analysis of IBM's presence in that market; and IBM does not have to have a product in order to have market presence. "IBM is the competition whether they have a product or not" is a ~~quote~~ quotation from past IBM research, ~~which~~ that has been repeated many times--and it bears repeating; IBM is omnipresent.

- As INPUT pointed out in Market Impacts of IBM Software Strategies, ~~(INPUT, 1984)~~, the key to market analysis is to determine IBM's primary emphasis in particular software product areas and then contrast that with the predominant trend supported by technology. The general software market analysis for the 1980s and 1990s was presented in that report, and will not be repeated here — except to summarize briefly IBM's strategies and technical challenges, and resulting vendor opportunities for the current SNA/DDP strategic period and the electronic office period ~~which~~ that follows.

  - IBM's predominant software direction during the remainder of the 1980s will be to maintain the highly centralized control inherent ~~under~~ in host-oriented operating systems. This strategy is dictated by ~~revenue~~ a dependency ~~from~~ on revenue from large-scale processors and magnetic storage systems. The IBM strategy is challenged by: optical memory

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developments, off-loading of mainframes to minicomputers under UNIX, performance problems from unanticipated data/information entropy, and the potential problems ~~of~~ in delivering enough MIPS with the von Newmann architecture. This analysis of IBM's strategy translates into the following ~~general~~ opportunities for competitive vendors during the late 1980s:

- Support of optical memories in appropriate applications.

- Support of off-loading of appropriate software functions to minicomputers and/or data base machines.

- Anticipat~~ed~~ion and understanding of the problems of data/information entropy inherent in IBM's software strategy, and the importance of energy (processing power) conservation in such an environment.

- Differentiat~~e~~ion of languages and decision support systems.

- Provi~~de~~sion of tools for performance monitoring and for improvement of host systems and the network.

- During the early 1990s, IBM's predominant software direction will be toward~~s~~ integration of the diverse systems and products ~~which~~ that currently ~~plague~~ complicate the issue of office automation into a new total office system. This strategy is dictated by IBM's need to grow from a $100 billion company to a $200 billion company during that period, and by the necessity for obsoleting all of ~~the~~ its old office products in order to achieve this growth. The challenges IBM faces in doing this are significant: new operating systems and network management facilities will be required; alternatives to IBM's solution may already in place; better competitive software may be available; and there may be sales resistance to electronic office technology from both labor

organizations and user management. There appears to be a window of opportunity for the following:

- Integrated communications--outlined operating systems.

- Mechanization of languages down to the workstation level.

- Development of expert systems employing knowledge-basis.

- Industry turnkey systems.

- IBM has the ability to adversely impact market acceptance (optical memories are an example), but its attempts to control technological acceptance creates opportunities as well. The above summary represents only a ~~very~~ brief description of the impacts and opportunities represented by IBM's software strategies. The reader is encouraged to refer to <u>Market Impacts of IBM Software Strategies</u> in order to understand the significance of these conclusions.

o In determining the productivity tools and aids required in the DSD environment, the general shift in emphasis from the large-host-oriented SNA/DDP period to the LAN-oriented electronic office period was considered; indeed, the shift is ~~synergistic~~ Compatible with, and even symptomatic of, the DSD environment. However, the tools and aids outlined in Chapter V must now be analyzed in relation ~~with~~ To IBM's software strategy, which is designed to maintain revenue growth through the sale of hardware. While IBM software revenue will be~~come~~ significant during the 1980s, it must be remembered that software revenue remains secondary to the primary objective, which is to support, prompt, and control hardware sales. This is important for several reasons:

- The pricing ramifications are obvious: when necessary to support initial hardware sales the software can be practically given away (as it

was in the days prior to unbundling). However, as systems software is enhanced (or corrected), the price tends to rise; and once complex hardware/software systems are firmly in place, prices can be adjusted with little regard for development or distribution costs, much less for value ~~(much less value~~ added).

- However, from the time of initial unbundling, IBM program products have been subject to normal product development procedures (forecasting, pricing, etc.). IBM doesn't like loss leaders, and the initial impetus toward unbundling was prompted as much by the desire to get the "programming mess" under control as it was to extract revenue from the customer. The discipline of the normal planning cycle has provided IBM with valuable insight into the potential economics of the software market (from IBM's point of view).

- For example, it would be surprising if IBM did not recognize the following:

  . IBM's software development costs are substantially higher than those prevalent in the software industry.

  . IBM's reputation as a software producer has not been good (either in the market or within IBM), and most "quality" software products have resulted from "bootleg" efforst outside the product development mainstream.

  . Nevertheless, IBM operating systems have probably contributed more to both account control and revenue (when resulting hardware sales are considered) than any other definable development effort in the compan~~ies~~y's history.

  . However, at the applications package and subsystem level, it has been impossible to schedule a successful "invention" or best-seller.

. IBM does not have to have the best software product in order to lead ~~in~~ the marketplace.

. IBM has a software distribution and maintenance system which cannot be duplicated by any potential competitor.

o ~~While~~ Whereas the primary objective of IBM's software strategy during the 1980s will be to maintin a ~~current~~ account control and To sell ~~well~~ hardware, IBM is also acutely aware that software/information is a high-growth area ~~which~~ that will become increasingly important to IBM's growth. IBM's market strategy is very simple:

- Since software/information ~~is going to become~~ will be increasingly important to IBM's growth, IBM must plan to dominate that market if it is to achieve its growth objectives.

- IBM does not have the human ~~development~~ resources in development to dominate the software market ~~at the present time~~. In fact, that market is not at all clearly defined. ~~However~~ In addition, even the amount of software necessary To support hardware sales is beyond IBM's current capability.

- The fundamental answer to this dilemma is alarmingly simple if you happen to be IBM: if you can't dominate the software market through sale of your own products, become the world's biggest market for software. Buy the winners (or near-winners) and use your distribution and maintenance system to control the market through resale. Thus, IBM has stated: "We are looking for software worldwide," ~~(~~and they have the money, and even the deals, to acquire what they need.~~)~~

- Software developers who want to take advantage of the world's best software distribution system (and sales organization) would do well to target their products ~~toward~~ at IBM as a potential customer, as well as at the current competition. IBM will make a lot of individuals and

organizations wealthy with their acquisition of software products during the 1980s, but you can be sure of one thing--house brands will eventually appear, and they will receive prefer~~red~~ential treatment.

o With IBM's ~~general~~ ubiquitous presence in the software market established, it is now possible to look at the general structure of the software market as ~~established~~ described in Market Impacts of IBM Software Strategies, and how the tools and aids needed for the DSD environment fit into that structure, as shown in Exhibit VI-1. Ex VI-1

- The Information Base Management System (IBMS) may be viewed as an application for managing both computerized and paper data/information dictionaries and directories. It differs from IBM's emphasis in the following ways:

  - IBM's current emphasis is upon integration of various encoded DBMS (such as IMS, DB2, etc.)--IBMS would ~~be designed to~~ mechanize communicaton and conversion across various systems (paper files and DBMSs).

  - From an applications point of view, IBMS runs counter to both IBM and GST directions (integration and differentiation), ~~it is~~ being a highly centralized application.

  - IBM's emphasis is upon highly centralized, host data/information/knowledge bases, Business Systems Planning (BSP) and Information Quality Analysis (IQA) series are designed to facilitate centralization--IBMS is designed to accommodate diversity (libraries, personal data bases, etc.)

  - While the primary software areas for IBMS are those listed in Exhibit VI-1, there are obvious operating systems implications in the implementation of the various subsystems under IBMS (see Exhibit V-4). (Ref. VI-1) (Ref. V-4)

- The Document Control System (DOCS) is one of the subsystems with obvious operating systems ramifications for storage management (with STET storage ~~being~~ including magnetic disk, file cabinets, library shelves, and micrographics systems). While both IBM and DOCS emphasis is upon centralization, DOCS is much broader in scope, and points to a significant opportunity to exploit IBM dependency upon magnetic disk storage revenue during the SNA/DDP strategic period.

- For example, an advanced implementation of DOCS could include ~~that of~~ an integrated image processing system, as presented in Impact of Upcoming Optical Memory Systems (INPUT, April 1983), and as shown here in Exhibit VI-2. Ex. VI-2

  - The system could incorporate IBM's Scanmaster, but would use optical disk for the bulk of document storage.

  - Pattern recognition (AI) is sufficiently advanced to permit updating of specific encoded data elements (such as document identification and specific transaction data) directly from the document being entered.

  - The specific implementation using a minicomputer or specialized controller also runs counter to IBM's continued strategy of centralized general pupose hosts, which means there is probably a substantial window of opportunity.

  - Variations on this type of system are needed now in order to prepare for the electronic office strategic period.

- The Data Flow Monitor (DFM) which was depicted in Exhibit V-~~4~~5 is really an extended network management facility. As such, it has obvious ramifications for IBM's continued heavy centralization of communications functions in the host computer. The use of ~~both~~ (Ref 5 Ex. V-~~4~~5)

specialized processors (minicomputer or microprocessor) and optical memory technology (disk and tape) as DFM is implemented at various levels in the computer/communications network, provid~~es~~ing a clear opportunity for alternatives to IBM's strategy during the SNA/DDP strategic period. IBM's snail-like progress in communications frontends (3705, 3725 etc.), and its refusal to make hardware performance monitors available (except as a "service" in competitive situations) practically ~~assures~~ guarantees that imaginative implementations of DFM (or portions thereof) will not have direct competition from IBM in the marketplace.

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- The tools of operations research and artifical intelligence ~~(OR and AI)~~ cut across all major software areas, and in the sense they are being ~~used~~ defined here, they actually represent tools to build tools. IBM has substantial AI research underway (including its support of university AI programs). Once again, windows of opportunity exist where IBM is reluctant to provide new hardware technology--specialized processors (such as LISP machines) or storage technology. ~~However,~~ INPUT feels, however, that IBM will first employ optical memories in advanced education systems and in early expert systems, so the window of opportunity based on employing that particular technology may not be significant ~~in those particular areas~~. Nevertheless, expert systems are really education systems in the broadest sense, and the need for such systems ~~(which not clearly defined at present)~~ to support the systems' development process is virtually unlimited.

- Security, protection, and privacy (SPP) problems associated with the DSD environment (and specifically with distributed data bases) represent a tremendous potential market ~~which~~ that is ideally suited for IBM ("whom would you rather sue?" was the question raised in Impact of IBM Software Strategies). From IBM's perspective, it has everything--an~~d~~ argument for SNA, an essential thread for software at all levels in the processing hierarchy, and hidden

hardware sales. It is extremely important to lead IBM in providing solutions to SPP problems--products which do not provide adequate ~~provisions for~~ security are not going to sell. (SPP requires substantial, additional research, both from a technical point of view and in terms of market analysis.)

- Fourth, fifth, and future generation languages (FGLs) are the driving force behind the DSD environment. They will become the means of making computer power available to everyone. IBM is confronted with integrating languages at various software levels under its highly centralized, host-oriented strategy. The opportunities for FGL differentiation (and mechanization) are substantial, but the quality problems ~~which have been~~ identified in this report are real, and will severely impact market opportunities unless they are addressed. ~~In other words,~~ FGLs must address performance problems and be implemented in an environment where quality has been restored to the base of the productivity pyramid. The FGLs ~~which~~ that are integrated with necessary tools and aids for quality control are going to be the successful ones.

B. FORECASTS

o INPUT has forecast systems software markets in the United States for three major areas:

- Applications development has been projected to grow from $1.~~7~~8 billion in 1983 to $10.3 billion in 1989. This represents an average annual growth (AAGR) of 34%.

- Systems control has been projected to grow from $1.1 billion in 1983 to $4.1 billion in 1989, for an AAGR of 24%.

- Data center management has been projected to grow from $0.65 ~~$651 million~~ billion in 1983 to $2.2 billion in 1989 for an AAGR of 23%. STET STET

- Overall, the entire systems software market is projected to grow from $3.5 billion in 1983 to $16.7 billion in 1989 for an AAGR of 29%.

o INPUT has also forecast that FGLs (including generalized tools, DBMS tools, code generators, and modeling languages) will increase from $0.75 billion in 1984 to $~~3.65~~ 3.7 billion in 1989. However, this forecast was adjusted during the last two years to reflect the impact of emerging expert systems (Trends and Opportunities in Fourth-Generation Languages, INPUT, 1984). This report suggests that expert systems will merely reflect language differentiation (tools to develop expert systems) and mechanization (actual expert system implementation) and should be covered under the broad INPUT category of FGLs.

o INPUT also predicted that IBM's worldwide software-related revenue (both applications and systems) would increase from $2.3 billion in 1983 to approximately $12 billion in 1989. At ~~the~~ present ~~time~~, INPUT estimates that 90% of IBM's revenue is from systems software, and 75% is from domestic sources. When applied to the domestic systems software market, this results in the following projections (see Exhibit VI-3): Ex. VI-3

- The total market for systems software is forecast to be over $16 billion in 1989, but that market must be reduced by nearly 50% (46.7%) if IBM is conceded its "share" of $8.1 billion. Therefore, the effective market for systems software is "only" $8.9 billion.

- The total systems software market is broken down into the three major categories ~~which were~~ mentioned earlier: applications development, systems control, and data center management.

o IBM penetration of the three major systems software categories is not distributed equally. Examination of these categories ~~will~~ permits a rough estimate~~s~~ of IBM penetrations by 1989.

- Systems control includes the following subcategories:

  - Access control.
  - Communications monitors.
  - Network control.
  - Operating systems.
  - Security systems.
  - Systems library control.
  - Windowing systems.
  - Others.

- Data center management includes the following subcategories:

  - Capacity management.
  - Computer operation scheduling.
  - Data center management.
  - Disk management.
  - Downtime/repair monitoring management.

- Job accounting.
- Performance monitors.
- Tape management.
- Utilities.
- Others.

- Applications development is divided into two categories; (program development and production tools, and data base management systems); these include the following subcategories:

  - Applications generation.
  - Assemblers.
  - Automatic documentation.
  - Compilers.
  - Debugging aids.
  - Languages (all generations).
  - System development control.
  - ~~System development control.~~
  - Retrieval system.

- Translators.

- DBMS's.

- Data dictionaries.

- Others.

- It is estimated that IBM penetration of the three major systems software categories in 1989 will be as follows:

  - Systems control--75%, $3.1 billion.

  - Data center management--35%, $4.2 billion.

  - Applications development--41%, $4.2 billion.

- This means the effective market for other competitors in the three major systems software categories in 1989 will be as follows:

  - Systems control--$1.0 billion.

  - Data center management--$1.4 billion.

  - Applications development--$5.1 billion.

o It is also apparent that the tools and aids needed to maintain quality in the DSD environment, and to prepare for the transition from the SNA/DPP period to the electronic office period, cut across many of the subcategories of system software. In addition, IBMS and DOCS (in some of their possible implementations) could be classified as a cross-industry segment of applications software (forecast by INPUT to be a $10.2 billion market by 1989). The research done during 1984, and the rapidly expanding and changing

software industry, disclose the need for a new software structure to reflect the realities of the marketplace. INPUT will do this during 1985.

o However, for purposes of this study we shall classify the tools and aids outlined in this report as extensions of FGLs. An "invisible FGL market" for application-specific software was identified in <u>Trends and Opportunities for Fourth-Generation Languages</u>, and the tools described in this report may be viewed as making that market visible.

- It is forecast that the tools and aids described in this report will add $1.5 billion to the original FGL forecast of $~~3.65~~ 3.7 billion in 1989.

- Therefore, the total market will be $~~5.15~~ 5.2 billion for an AAGR of 47%.

- To a large ~~degree~~ extent this high growth rate results ~~for~~ from a broad interpretation of FGLs and the inclusion of the invisible market. However, it is INPUT's opinion that unless the questions of data/information quality and systems performance are addressed by FGLs, they will prove to be self-defeating. We are betting that will not happen.

- It is also forecast, that IBM penetration of this market by 1989 will be only 30% ($1.5 billion) leaving a total effective market of $~~3.65~~ 3.7 billion.

VII

VII CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

o In an effeort to improve productivity, and the responsiveness of the IS function, the general trend during the last five years has been to get end users more ~~closely~~ involved in the systems development process. This trend manifests itself in the following ways:

- ~~The~~ An increased emphasis upon information centers, with strong ~~endoresement~~ endorsement from major vendors--specifically, from IBM.

- The enthusiasm for prototyping as an integral part of the systems development process.

- The proliferation of standalone personal computers, which gave considerable incentive to the IS function to get end users involved.

- The rush to link micros to mainframes--which is IBM's way of establishing control through its highly centralized, host-oriented systems network architecture.

• INPUT refers to this general trend as distributed systems development (DSD).

- INPUT, while recognizing that user involvement in the systems development process is important, has stressed that any program of productivity improvement must be built on a bas~~e~~is of ~~an~~ commitment to quality. In the results-oriented DSD environment, commitment to quality has been relegated to relatively low priority.

- There is currently a high risk that the DSD environment will result in the following:

  - The development of systems with such poor performance that they will exceed the capacity of host mainframes (or at least cannot be cost justified).

  - Data base synchronization and integrity problems ~~which~~ that may in turn result in the rapid deterioration of data quality.

  - Data base protection and security problems, which are currently not understood--much less solved.

  - The contamination of essential information flow with conflicting and inaccurate reports.

- The tools and aids used to facilitate the DSD environment, by their very effectiveness, will contribute to the quality problems ~~which~~ that are anticipated. To the degree that products (specifically FGLs) do not address these problems, their use will be limited. On the other hand, products which do address the problems of quality ~~which~~ that have been outlined represent an outstanding business opportunity.

- IBM's traditionally conservative approach to distributed processing under SNa is essentially designed to maintain revenue growth from host hardware. This IBM emphasis upon centralization will continue through the 1980s (SNA/DDP period); and, considering the problems outlined above, a good argument can be

made that this strategy is precisely what is required ~~at the present time~~. However, by understanding IBM's strategy, substantial windows of opportunit~~ies~~y ~~exist~~ become apparent--especially in anticipation of the advances in office automation antipated in the early 1990s (electronic office period).

- FGLs (by INPUT's definition) have been the driving force behind much of the DSD environment, and INPUT concludes that they can be extended conceptually to include a full range of applications development products, including those associated with quality control and emerging expert systems.

- A holistic view of software systems is necessary in order to give general structure to a complex problem. (This necessity was first recognized by the application of general systems theory concepts in Market Impacts of IBM Software Strategies.) The DSD environment requires ~~a perspective and~~ an emphasis on software systems ~~which~~ that address data/information flow, rather than on the more static concept of software packages. Otherwise, basic design conflicts occur.

- INPUT concludes that analysis, restructuring, and redefinition of the software market is essential if more meaningful product forecasts are to be made. It will be a primary corporate objective for us during 1985.

B. RECOMMENDATIONS

- Vendors should understand IBM's hardware/software strategy and its impact on the software market. Like it ot not, IBM's strategy will define both the market and the opportunities for competitors. A software product strategy which is synergistic with IBM's is not only desirable, but may become essential for survival. INPUT recommends Market Impacts of IBM Software Strategies as a place to start. It is somewhat complex, and you may not agree with portions of it, but it does provide a general frame of reference for the market.

- o Recognize and understand the seriousness of the potential quality problems associated with the DSD environment and the fact that many current tools and aids are contributing to the problem. Develop products which become part of the solution rather than remaining part of the problem.

- o Identify hardware/software products which IBM has little current incentive to develop because of possible impact on its business plan. Associate those products with the problem solutions of the DSD environment.

- o Develop products synergistic with IBM's strategy, in the sense that they fill needed gaps and solve real problems.

- o View IBM as a separate potential market for software products where their software product line is deficient and they need software ~~in pursuit of~~ to pursue their strategy. When possible, consider this potential market during product design.

- o Take a holistic approach to solving the productivity problem, with special emphasis upon systems quality as the primary design point of tools and aids.

- o T~~o~~ap the invisible market by developing applications systems ~~which~~ that address data/information flow quality during the transition from the SNA/DDP period to the electronic office period.

- o The representative tools and aids presented in this report ~~are~~, at least, roughly indicate ~~representatives of~~ potential areas of opportunity in software productivity, and they will be refined by INPUT in the future. ~~Use them as such.~~

M-SSP

EXHIBIT II-1

IMPACT OF NEW SOFTWARE PRODUCTIVITY TECHNIQUES

- **Manifestations of Impact**
  - **Information Centers**
  - **Prototyping**
  - **Microcomputer Acceptance**
  - **Micro-mainframe Links**
  - **Distributed Systems Development (DSD)**
- **The Promise**
- **The Problems**
- **The Opportunity**

EXHIBIT II-2

THE GOOD NEWS

Growing ~~Good~~

- Demand for Fourth, Fifth & Future Generation Languages ~~(FGL's)~~ STET

Fourth Generation Languages

- Integration of FGL's, DBMS's & Code Generators

of FGLs and DBMS

- Extension to Intelligent Workstations
- User Involvement
- Tangible Results

EXHIBIT II-3

THE BAD NEWS

- Serious Problems are Anticipated
  - Data Base Integrity & Synchronization
  - Security, Protection & Privacy
  - Conflicting Reports to Management
  - Over-burdened Hosts
- Counter-Productive Systems Development
  - Deterioration of Data/Information Quality
  - Unanticipated Expense
  - Unworkable Solutions
  - "Eternal" Systems Development
- Waiting for Failure

EXHIBIT II-4

NEW TOOLS & AIDS NEED ED TO CONTROL DSD

- An Information Base Management System (IBMs)

- A Document Control System (DOCs)

- A Data Flow Monitor (DFM)

- "Connected" Operat~~ing~~ions Research & Artificial Intelligence Tools (OR & AI)

- A Security, Protection & Privacy System (SPP)

EXHIBIT II-5

~~IBM & FGL's~~
~~- THE~~ KEY~~S~~ TO THE DSD MARKET

FGL's:

- FGL's are the Driving Force Behind DSD
- Extend FGL's to Include Control Tools
- Develop the Invisible FGL Market
- Exploit the Gaps in IBM's Software Strategy
- View IBM as a Potential Market

EXHIBIT II-6

EXPANDED FGL MARKET FORECAST

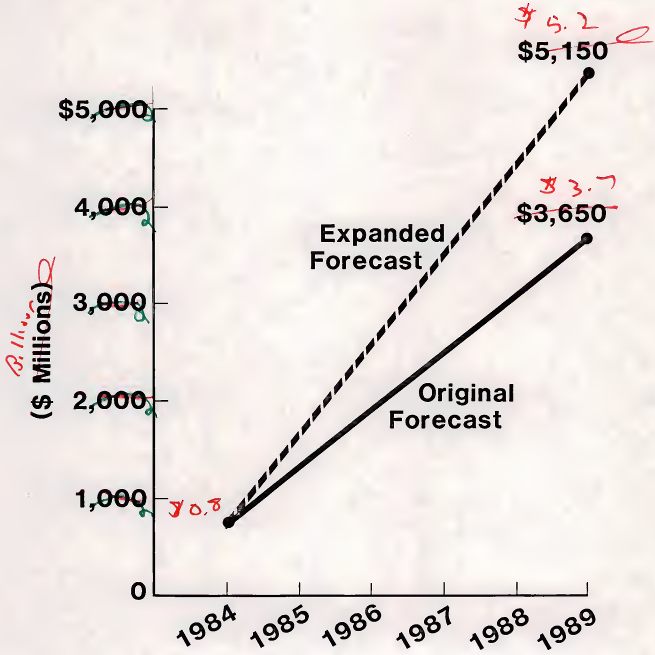


EXHIBIT III-1

~~RESPONDENTS'~~ REPORTED IMPLEMENTATION OF DSD ENVIRONMENT
(30 Respondents)

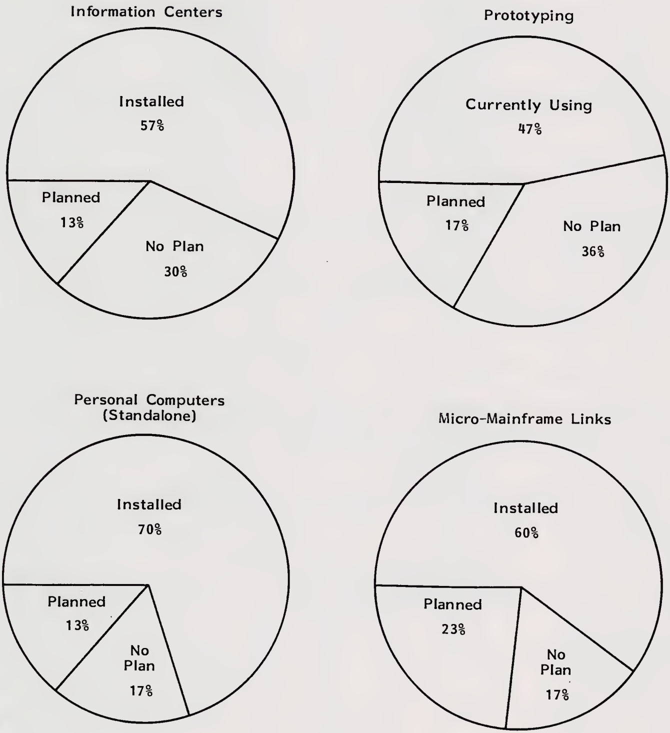
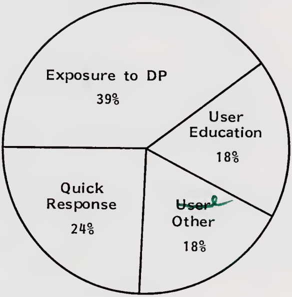


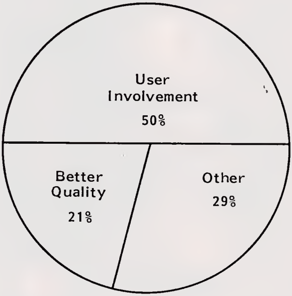
EXHIBIT III-2

REPORTED ADVANTAGES OF DSD IMPLEMENTATIONS
(Percent of Responses)

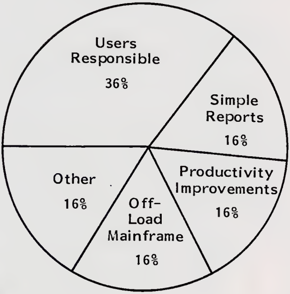
Information Centers



Prototyping



Personal Computers (Standalone)



Micro-Mainframe Links

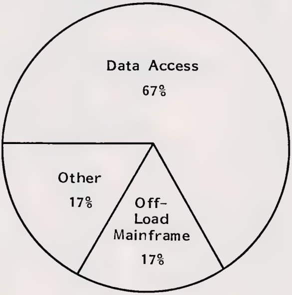


EXHIBIT III-3

REPORTED DISADVANTAGES OF DSD IMPLEMENTATIONS

(Percent of Responses)

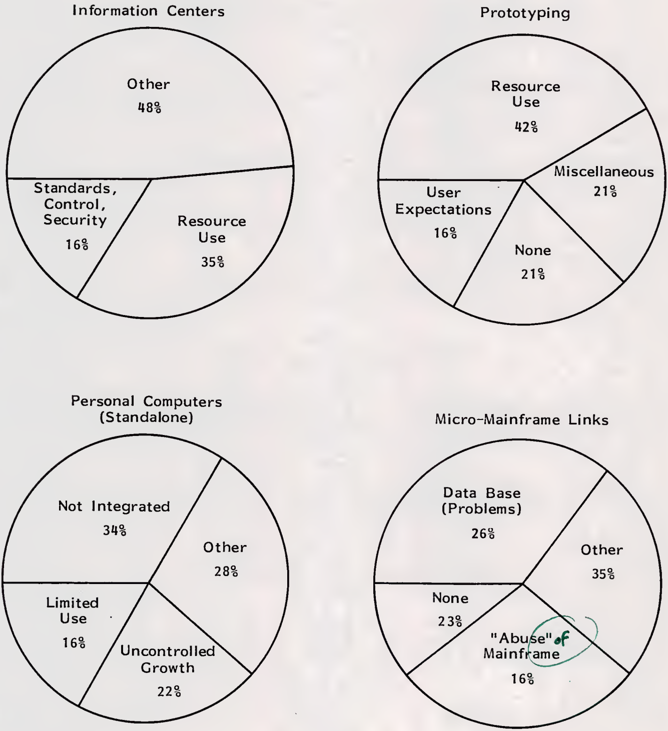
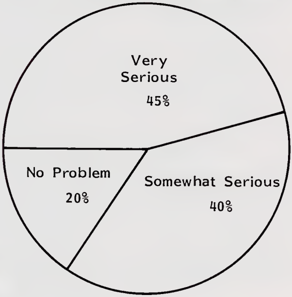


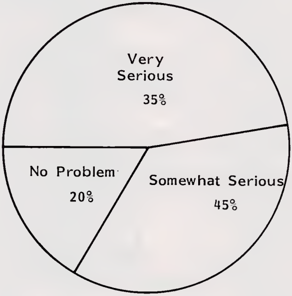
EXHIBIT III-4

I.S. RESPONDENTS RATING OF POTENTIAL DSD PROBLEM AREAS
(Composite Ratings)

Distributed Data Base Management



Information Flow



Mainframe Impact

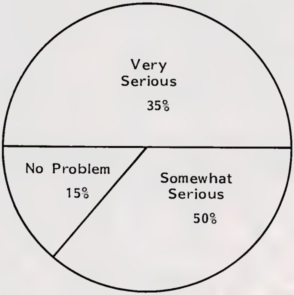
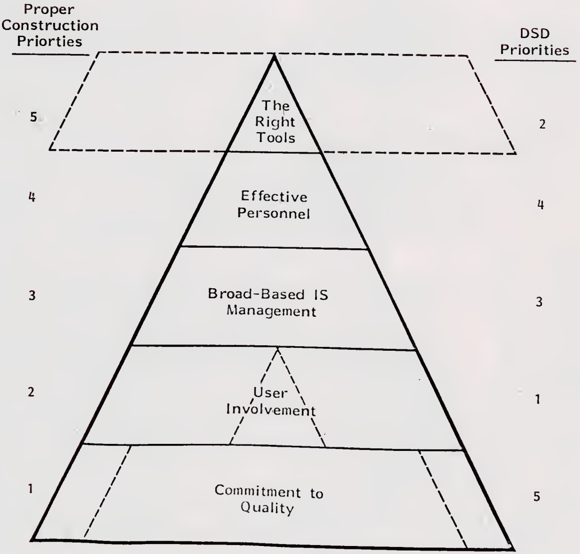


EXHIBIT III-5

THE PRODUCTIVITY PYRAMID
(And Its DSD Reconstruction)



Original pyramid
Reconstructed pyramid

EXHIBIT IV-1

ENTROPY IN THE DSD ENVIRONMENT

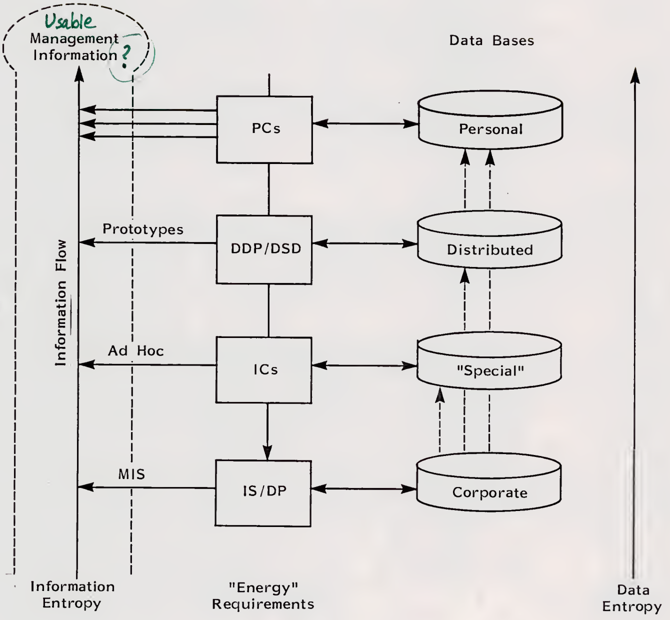


EXHIBIT IV-2

IBM STRATEGIC SOFTWARE PERIODS

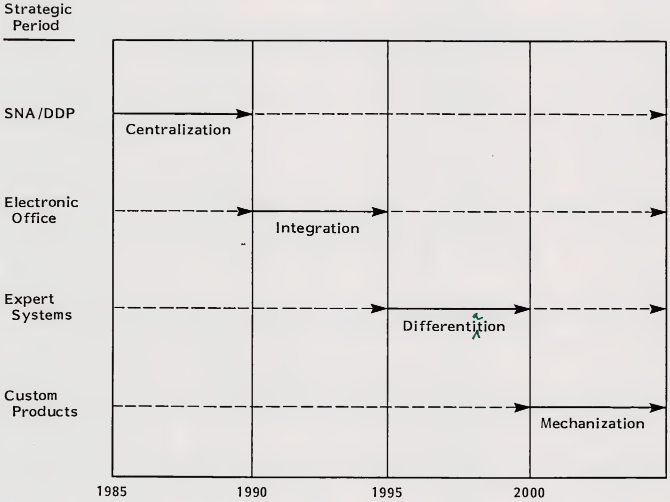
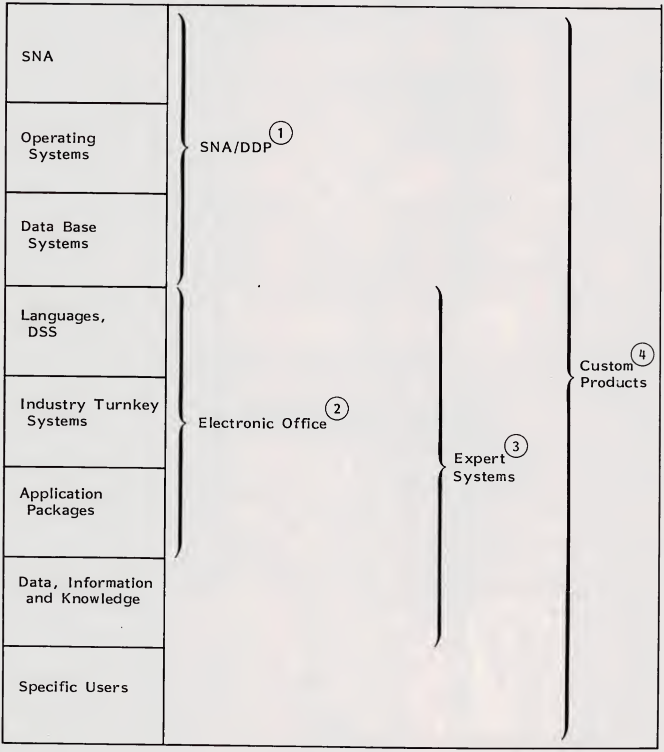


EXHIBIT IV-3

IBM SOFTWARE FOCUS BY STRATEGIC PERIOD



Exh IV-4

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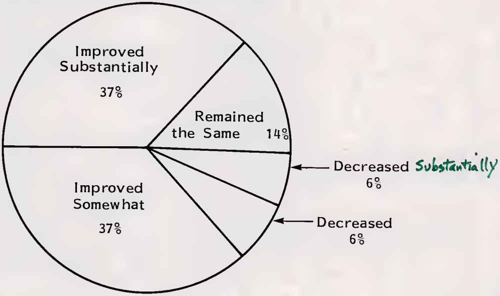
EXHIBIT IV-5

PRODUCTIVITY CHANGES IN SINCE 1980

(Respondents Selected from Multiclient Study)

How Productivity Has Changed



What Contributed to the Change

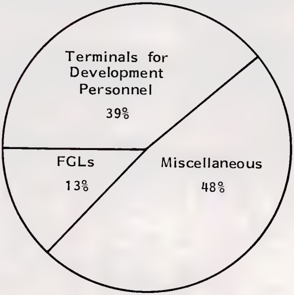
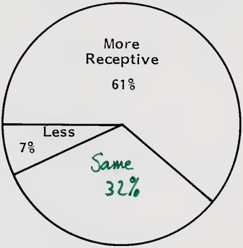


EXHIBIT IV-6

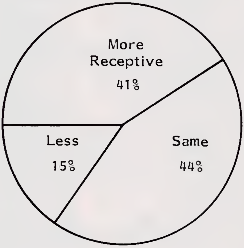
ATTITUDES TOWARD~~S~~ CURRENT ALTERNATIVE PRODUCTIVITY APPROACHES

(Compared to 1980)

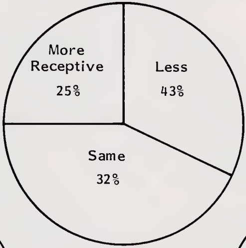
Applications Packages



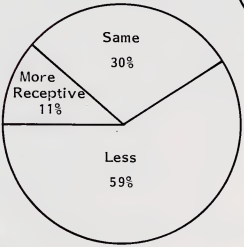
Industry Turnkey Systems



Outside Systems and Programming Assistance



Outside Processing Services



Fourth-Generation Languages

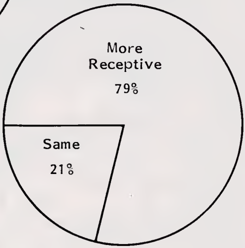


EXHIBIT V-1

TOOLS, AIDS AND APPROACHES TO FACILITATE DSD
(IS Management Respondents)

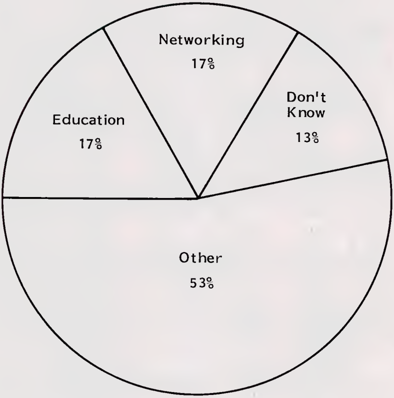


EXHIBIT V-2

TOOLS, AIDS AND APPROACHES TO CONTROL DSD
(IS Management)

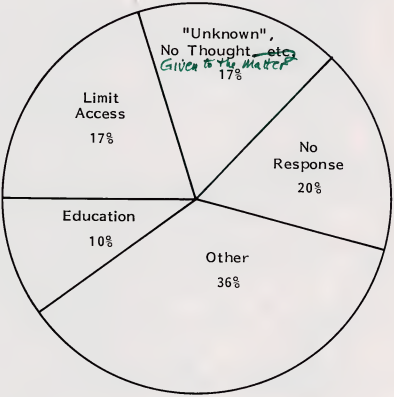


EXHIBIT V-3

THE FUNDAMENTAL CHANGES IN I.S. MEDIA

Graphics - Try not to break up these words. If so, then CALCULA-TION/MANIP-ULATION

	INPUT	COMMUNI-CATIONS	CALCULA TION/ MANI PULATION	STORAGE	OUTPUT
Predominant Media Prior to 1800	Paper	Paper	Paper	Paper	Paper
Productivity Improvement 1800-1900	Cash Register (1888)	Telegraph (1837) Telephone (1876)	Adding Machine (1888) Punch Card Equipment (1896)		Typewriter (1867)
Predominent Media 1900-1950	Paper Transactions, Books, Reports Etc.	Paper Corespon-dence (Mail)	Paper (Including Punch Cards, Mathematical Tables, Etc.)	Paper File Cabinets, Libraries	Paper Memos, Reports, Letters
The Computer "Revolution" 1950-Present	Terminals, Intelligent Work-stations	Satellite, Broadband, LANs, Etc.	Computers	Disk and Tape Storage, Micro Graphics	Copiers, Word Processors, Printers, CRTs
Predominant Media	Paper	Paper	Electronic	Paper	Paper
Projected 1990s "Electronic Offices"	Electronic	Electronic	Electronic	Electronic	Electronic

EXHIBIT V-4

AN INFORMATION BASE MANAGEMENT SYSTEM (IBMS)

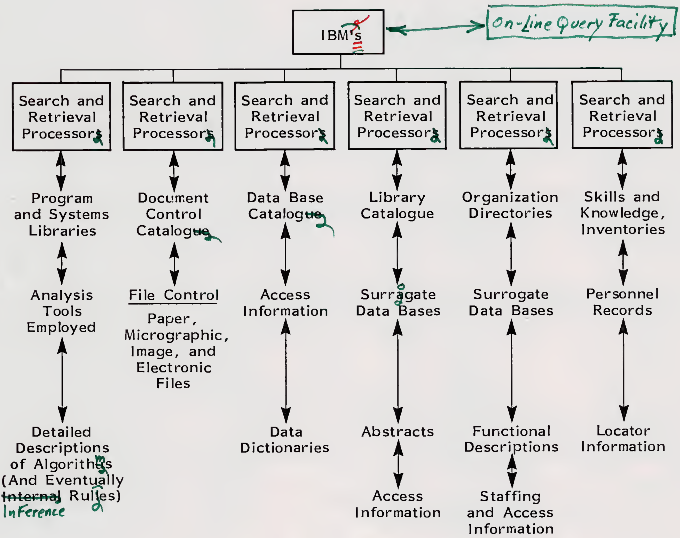
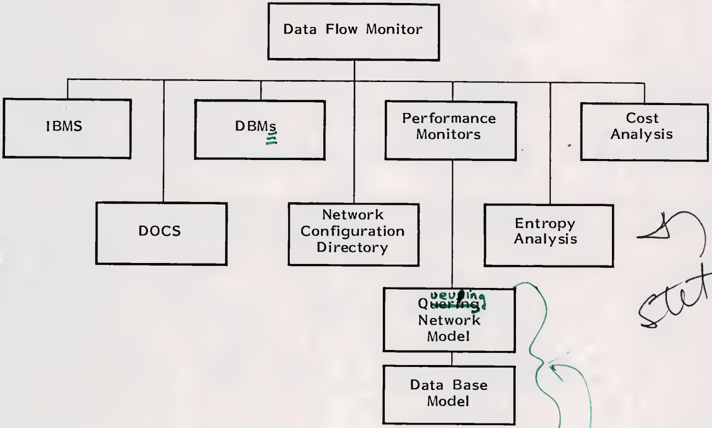


EXHIBIT V-5

A DATA FLOW MONITOR

(DFM)



stet

Graphics - Please turn this on its side and have all boxes below Data Flow Monitor on the same level, except for which can extend below - HHANK

O.K. per Jack Keen

EXHIBIT VI-1

DSD SOFTWARE MARKET STRUCTURE
(SNA/DDP Period - 1984 to 1989)

SOFTWARE AREA	Integration	Differentiation	Mechanization	Centralization	TOOLS & AIDS NEEDED: IBMS	DOCS	DFM	OR & AI	~~SPD~~ SAP	FCL
Operating Systems										
Process	IBM	X						●		
Storage Management				IBM X		●			●	
Protection & Security		X		IBM			●		●	
Resource Allocation	X			IBM			●	●		
System Structure			X	IBM					●	
Hardware/Firmware/Software			X	IBM		●	●	●	●	
Data Base Management Systems	IBM		X		●	●	●		●	
Languages, DSS	IBM	X						●		●
Industry Turnkey	X IBM	IBM	X	IBM						
Applications Software	IBM	X			●	●		●		
Data/Information/Knowledge		X		IBM	●	●	●	●		

Key: IBM = Predominant IBM Direction

X = GST Direction

● = Primary Software Areas for Tools and Aids

Graphics –
For Exhibit VI-2

Please use

Ex. IV-4 from

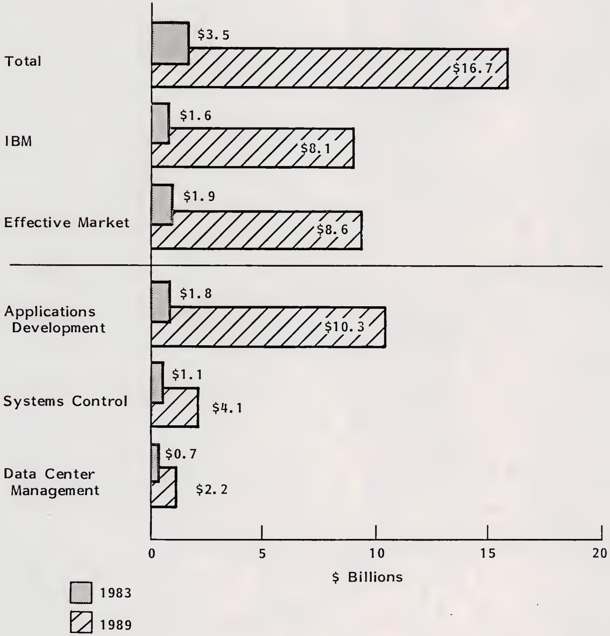
U-VDS

1983

EXHIBIT VI-3

SYSTEMS SOFTWARE FORECAST

(1983 to 1989)



APPENDIX A:

USER QUESTIONNAIRE

Note to wp
use USSP
questionnaire
here

ORGANIZING END-USER DEPARTMENTS FOR INFORMATION SYSTEMS

Soft Bound

U-EOR BACKUP

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U-EOR

ORGANIZING END-USER DEPARTMENTS FOR INFORMATION SYSTEMS

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	B. IS Must Assume Leadership of the Corporate Computing Activities 8	
	C. IS Must Accommodate ~~the~~ End Users 10	
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Any Appendices? no

ORGANIZING END-USER DEPARTMENTS
FOR
INFORMATION SYSTEMS

EXHIBITS

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U-EOR-I

I INTRODUCTION

A. PURPOSE

- This report is part of INPUT's Information Systems Program (ISP). It identifies the issues that information systems (IS) must address to provide the necessary leadership to realize the potential benefits of end-user involvement in systems development.

- The report answers the following questions:

  - What has caused the flurry of activity in end-user computing?

  - Where is the trend in end-user computing taking the information systems function?

  - What are the ramifications of end-users developing their own systems with little or no direction from IS?

  - What steps can IS take to improve its credibility and assume the leadership role of all computing activities?

B. SCOPE

- This report will focus on the analysis of alternate approaches being used to manage and direct the phenomenon of end-user involvement in computing activities. It will examine the organizational ramifications of end-user computing from the viewpoints of both the corporate IS and the end-user departments. This report does not address the technical aspects of connecting hardware or downloading data bases. ~~but~~ Instead, it deals primarily with tactical and strategic issues surrounding the entire information systems function.

- The following people should find this report pertinent:

  - IS managers.

  - IS planners.

  - End-user managers.

  - Senior corporate managers.

C. RELATED INPUT REPORTS

- Executive Workstation Acceptance: Problems and Outlook. ~~April 1984.~~ ✓

  - This report identifies executive computing requirements, analyzes products, and recommends executive computing support strategies.

- Supporting Personal Computer Software. ~~August 1983.~~

  - This report describes the planning and organizational issues of personal computer software support. It also provides a guide to maximizing the benefits of personal computer software.

- Organizing the Information Center. ~~July 1983.~~

  - A key issue is the extent to which the information center is complementary to, or an alternative for, the personal computer.

- The Opportunities of ~~End-User Experiences with~~ Fourth-Generation Languages. ~~August 1983.~~

  - Can fourth-generation languages help make the centralized mainframe competitive with the PC?

  - What role will current or future fourth-generation languages have on PCs?

- End-User Micro-Mainframe Needs. July ~~November~~ 1984.

  - This report concentrates on the experiences of organizations that use personal-computer-to-mainframe systems. It also identifies systems requirements and projects future effects.

- Micro-~~to~~-Mainframe Telecommunications. ~~October 1984.~~

  - Analyzes, in detail, personal computer communications modes, their advantages and limitations, and how these communications are likely to change in ~~the~~ next two to three years.

- Training Techniques for End Users~~, June 1984.~~

  - This report covers initial and on-going training and support for end users of personal computers, personal workstations, word processing, office systems, and information computing provided by IS.

- Future Skills Requirements for Software Development~~, October 1984.~~

  - This report examines many of the latest productivity schemes to determine the impact the new methods are having on the skills mix of IS.

II

II EXECUTIVE SUMMARY

- This executive summary is given in presentation format to help the busy reader quickly review key research findings. It also provides an executive presentation, complete with script, to facilitate group communications.

    - The key points of the entire report are summarized in Exhibits II-1 through II-3. On the left-hand page facing each exhibit is a script explaining that exhibit's contents.

A. DISTRIBUTED SYSTEMS DEVELOPMENT WILL CHANGE THE I.S. ROLE

- As ~~departments~~ business operations throughout organizations in most industries install clustered intelligent terminals to handle the variety of computing tasks associated with the business functions, applications analysis and programming will be dispersed and under the control of ~~the~~ line management. Personal computing, office systems, and transaction-driven systems will be developed by these local information~~s~~ systems groups.

- The more computing capabilities that are given to the work force of an organization, the more dependent that organization becomes on the technology to survive and thrive. This trend will push IS up the corporate ladder as the technical advisor. Computer capacity planning, data and voice communications, application~~s~~ integration, education and training, corporatewide standards, and hardware and software consultation will become the main IS responsibilities.

- Future systems development at the local level will rely more heavily on fourth-generation languages, proprietary applications software, and program generators. IS will provide technical support and systems development consultation to ensure continuity and uniformity.

B. I.S. MUST ASSUME LEADERSHIP OF THE CORPORATE COMPUTING ACTIVITIES

- Because of the onrush of computing tools directed at the work force, there is a need for planning and controlling the use of these tools to ensure maximum benefits. IS is the only entity within an organization ~~with~~ that has the technical know-how to manage the end-user computing phenomenon.

- Good leaders are influential and persuasive. IS must provide adequate computing alternatives and then sell ~~the~~ end-users on the benefits of following IS's recommendations. This can be accomplished by expanding the information center to include the type of microcomputer products supported by IS. IS should also consider adding a marketing function to the information center to sell ~~the~~ end-users on the idea of using those products that are supported by IS, and to sell end-users on the benefits of seeking IS assistance.

- In the future, IS will devote more of its energies to investigating innovations in computer applications that will assist the organization in becoming a leader in its field. Senior management will rely on IS to uncover competitive stratagems.

- IS is evolving from a service function that reacted to requests from end users to a proactive strategic planning function. During this evolution IS is helping ~~the~~ end users to discover the capabilities of computer technology.

C. I.S. MUST ACCOMMODATE ~~THE~~ END USERS

stet

o Changing the primary role of IS from systems development to consulting is not going to happen over night. This movement of computer resources towards the end users started with report program generators back in the 1950s and has progressed with terminal devices and micro technology.

o There are immediate steps IS can take to make certain that the end-user computing revolution is under control and on the right track to best service the organization in meeting its goals and objectives: IS should:

- Establish an end-user computing steering committee to set policy and approve plans.

- Help the end-user community establish a internal users group.

- Issue an end-user computing reference manual with policies and practices.

- Establish a center to provide information on microcomputers.

- Offer training, tours, demonstrations and consultation.

o ~~The~~ end users must believe that IS is ready and able to accommodate their individual computing needs. This will only happen if IS has the tools available and the expertise to assist the end users.

III

III ISSUES

A. I.S. CREDIBILITY

- One of the main reasons for the whirlwind of activity and interest stet ~~in the~~ stet ~~end~~ users being able to solve some of their own information systems problems has been the lack of confidence in IS's ability to deliver. ~~The~~ end users have become frustrated with empty promises from IS.

- IS has been a victim of circumstances, and in most cases, doesn't deserve the negative criticism. ~~Be that as it may,~~ from the end-users' standpoint, ~~the perception is that~~ IS has been unresponsive to their individual needs.

- From the inception of digital computer technology in business, the main thrust of IS has been towards the transaction-driven systems. Senior management has demanded that IS resources be devoted to reducing operating costs and improving the production process. Applications development activity has been closely scrutinized to ensure a tangible return on the investment.

- Typical major systems have had two to three-year development life cycles with many delays and missed target dates along the way. Project teams and management review boards have been formed to oversee these massive systems, but it always seems that IS gets the brunt of the blame for encountered problems.

- Probably the most common problem encountered during the development of a corporate system is the frequent requests from a variety of end users to change the specifications to meet some new-found information need. ~~Enough~~ So many of these requests go unanswered, ~~because of~~ due to schedule constraints, ~~that~~ IS's credibility suffers. stet comma stet

- To the individual end users IS appears ~~as~~ to be a mountain of bureaucratic red tape ~~as~~ illustrated in Exhibit III-1. III-1

B. USERS' DEMANDS

- Users' needs and wants haven't changed appreciably through the years. They have always had to exchange correspondence, prepare special reports for management, schedule and track projects, follow up on special requests, and manage their time. Those day-to-day functions listed on Exhibit III-2 have been the main stay of line managers' duties from the beginning of business. III-2

- During the past 25 years, when senior management wanted ad hoc information concerning the status of some business process within the company, the user (in this case, line management) would select bits and pieces of data from various sources, including computer reports, and laboriously analyze the data using desk calculators. Invariably, senior management would request additional information to compare and draw conclusions on which to base business decisions. Line management would request additional ad hoc reports from data processing, and this iterative process would continue until senior management had exhusted all combinations of data comparisons.

- Unfortunately, there are still companies ~~where~~ in which the ~~above~~ manual manipulation of data continues; ~~and~~ the ~~information systems~~ (IS) departments of those companies are inundated with requests for special reports. ~~The problem has been that~~ In such instances, IS has been unable to respond as quickly as top management desires,

which, of course, makes middle management look incompetent ~~and the IS-user relations suffers~~. The Relations between IS and end users suffer, therefore.

o In the past, ~~The~~ end users ~~that~~ who spend spent a great deal of their time analyzing the factors that ~~effect~~ affect the profits and losses of an organization ~~were~~ became easy targets for the vendors of microcomputer equipment and software. ~~The~~ end users ~~saw~~ saw an opportunity to bypass the IS roadblocks by operating their own computer and preparing their own reports. Along with preparing their own information systems reports, ~~the~~ end users ~~could~~ envision automating their office procedures and duties.

C. USERS' ~~D.P.~~ DATA PROCESSING NAIVETE

o The personal computer started finding its way to ~~the~~ end users in the early 1980s. IS didn't give it much thought initially and probably viewed it as a means of some relief from the pressure for information.

o ~~The~~ end users worked enthusiastically with the vendors installing and learning how to use their new computer tools. ~~At the end of 1982~~ INPUT's ~~published a~~ report ~~entitled~~ Personal Computers in the IS Strategy ~~(December 1982) that~~ indicates ~~found~~ that IS was considered to be in fourth place as a source of assistance for personal computer users. ~~The~~ Some statistics from that report ~~on this issue~~ are shown in Exhibit III-3. III-3

o Unfortunately, without the proper direction from IS, end users usually made incorrect assumptions about the capabilities of ~~the~~ personal computers. ~~They were right back~~ Users resorted to selecting bits and pieces of data from IS reports ~~and~~ to rekey~~ing them~~ into ~~the~~ personal computers.

D. VENDOR'S PROMISES

- One of the major issues a ~~e~~ffecting end-user computing has been ~~the~~ reliance on ~~the~~ vendors for assistance in building applications for the personal computer. To remain competitive, ~~the~~ vendors have wanted to please the ir customers; ~~and~~ in doing so, they have sometimes overlooked important factors such as documentation, controls, and security.

- ~~In~~ Exhibit III-4 ~~INPUT is~~ does not impl~~ying~~ y that every end-user computing activity requires stringent controls. ~~The point is,~~ as end users become more sophisticated in their applications of personal computers (including links to ~~the~~ the mainframe and local area networks), they need to be aware of sound IS practices. ~~The reasons for, and the~~ Knowledge about the steps on the Exhibit ~~III-4~~ can only come from IS. III-4

E. I.S. LACK OF INITIATIVE

- About ~~It hasn't been until the past~~ three years ago ~~that~~ IS ~~has shown~~ began showing real interest in helping ~~the~~ end users manage their day-to-day affairs. Word processing has been around for some time and office systems have been trying to get off the ground, but end-user computing didn't really take off until the concept of the information center. These centers are managed by IS and provide the tools to ~~the~~ end users that allow them to extract data directly from the corporate data bases ~~and~~ to perform analyses and build information models.

- IS's involvement in helping ~~the~~ end users organize for information systems has been slow in coming, but now most IS managers realize the impact end-user computing will have on future corporate systems development.

o IBM's strategy has always been directed at bringin~~t~~g the capabilities of computer technology to ~~the~~ end users. The concept of the information center was introduced by IBM in the mid-1970s to support the long-range objective of end-user computing. IS saw the information center as an opportunity to improve its credibility by providing end users with tools ~~to the end users~~ that would cut through the red tape of service requests and deliver immediate results.

o As illustrated in Exhibit III-5, over 80% of the respondents ~~to this study~~ believe that end-user computing will be an integral part of future corporate systems development. The following chapters will outline steps that have proven to be successful for many IS organizations in their ~~pursuit~~ efforts to facilitate end-user computing.

IV

IV TECHNIQUES FOR IMPROVEMENT

A. TRAINING CENTER

- ~~In~~ INPUT's study ~~entitled~~ Training Techniques for End Users ~~(June 1984) it~~ points out that computer literary, operating skills, and the ability to apply ~~the~~ computing tools to business needs are the three major goals of end-user training.

- Training can also be an excellent vehicle for IS to gain control over the direction of end-user computing, which INPUT believes is essential for the future success of information systems in any organization. The trend is toward greater user involvement in systems development and computing, which will require ~~the~~ IS leadership ~~by IS~~.

- Exhibit IV-1 lists action items for IS ~~relative to~~ training and education. IV-1
INPUT's survey indicates that companies are establishing microcomputer centers along with the information center. The microcomputer center houses samples of all ~~of~~ the IS-supported micro-equipment and software products. End-users are encouraged to visit the center for demonstrations, seminars, and one-on-one, hands-on training. If a company is dispersed over a wide geographic area, microcomputer centers can be placed in each major location.

- Formal courses on security and control policies and practices should also be considered, to instill these fundamentals in end users who are planning to develop their own systems.

B. END-USER COMPUTING GROUP

- o Thirty-five percent of the companies that are supporting end-user computing have established user groups ~~according to INPUT's survey.~~ Forty-five percent claimed to be in the process of organizing such ~~a~~ groups.

- o INPUT believes the benefits of ~~a~~ users' groups will include the following items, ~~which are~~ summarized in Exhibit IV-2: IV-2

    - Improved resource utilization through the exchange of ideas and concepts.

    - Increased chances for compliance to compatibility standards through peer pressure.

    - Formal organization for disseminating information related to end-user computing.

    - Better acceptance of products and services through end-user involvement in their evaluation and selection.

    - Assisting IS in identifying areas for trying new products.

- o INPUT recommends structuring the users' group in a similar fashion to the IBM users' groups, ~~of~~ GUIDE and SHARE. The group should be ~~for the~~ end-user oriented; ~~and~~ ~~by the end users.~~ The board of directors should consist ~~be comprised~~ of those end users who have had considerable computing experience. IS should take an advisory role and be asked to make presentations but should not assume any management responsibilities.

end users, should, comprise, the group.

- IS should initiate this activity by calling together the end users ~~that~~ who have been more aggressive in applying computer technology to their functions, and by presenting ~~to this groups~~ an outline of the bylaws for an end-user computing stet users' group.

stet but add apostrophe

- In some large metropolitan areas, ~~there are~~ personal computer associations are established for the exchange of information. ~~which~~ These groups should be investigated for possible membership. ~~This~~ They would also provide an excellent source of information for the in-house user groups, both ~~from an~~ organizational ~~standpoint~~ and for topic ideas for future agenda~~s~~. stet stet

C. STEERING COMMITTEE FOR END-USER COMPUTING

- Another way to aid ~~the~~ end users in their information systems endeavors is to establish an end-user computing steering committee or review board. If there is already an active IS steering committee, investigate the possibility of including end-user computing matters in the charter.

- This group should publish a policy on the acquisition and employment of computer-related products and services that are directed toward~~s~~ end-user consumption. For example, if every purchase requisition for information system resources (e.g. personal computers) requires IS approval, ~~then that~~ it should be spelled out in the policy.

- The issuance of a compatibility standard, listing the preferred vendors and acceptable configurations, was selected as being of high importance to nearly all of the survey respondents. One of the duties of the steering committee could be the approval of additions to or deletions from the compatibility standard~~s~~.

- Major undertakings, such as the installation of local area networks and associated office systems should be reviewed and approved by the steering committee.

- Any alternations to the rules and regulations governing end-user computing would require the approval of this group. This would raise the authority on such matters above IS to ensure compliance and acceptance.

- Exhibit IV-3 list the suggested membership and charter for an end-user computing steering committee. This group should consist of approximately six members with representatives from the major areas being effected. The committee's involvement in the approval process of an end-user computing activity could be based on the cost of such an activity or on the proposed deviation from established practices. IV-3

D. IMPROVING I.S. VENDOR RELATIONS

- ~~If not managed the~~ vendors of information services products will naturally try to sell their wares to the ~~people~~ who they believe ~~will~~ make the decisions. IBM has been known to call an president of companies if it isn't making headway with the IS organization. ~~In the case of~~ office systems and microcomputer products, ~~the~~ suppliers of ~~these items~~ have been dealing mostly with the department managers whose groups are directly effected.

- INPUT believes that it is the responsibility of IS to coordinate and manage procurement activity related to computer technology. IS has the expertise in systems design and the experience in selecting the most cost-effective solutions to business problems. IS also assesses products from a global perspective to ensure compatibility and future interconnection.

- In order for IS to take charge of the evaluation and selection of companywide information services products it must:

  - Provide consulting services to the end users of office systems and microcomputer products.

  - Expound on the benefits of including IS in the procurement decisions of computer technology.

- Chapter V will point out steps that IS can take to include consulting services in its organizational structure that will encourage end users to seek assistance from IS rather than directly from the vendors.

- As a member of the steering committee for end-user computing, IS has the opportunity to initiate a policy that will cl~~e~~arify IS's role in the decision-making process of computer-based products. IS must share its strategic thinking with the steering committee so that the committee can review requests against an overall plan.

- Vendors should be made aware of the procurement policy of the corporation to include IS in the decision process. They should also be made aware of the opportunity of addressing a large audience of end users through the users' group if they work through IS.

- IS should coordinate the following activity for those vendors that pass a preliminary evaluation by IS:

  - Demonstrations to end users.

  - Tours of vendors' customers' facilities.

  - Pilot installations.

- Presentations to the users' group.

- Presentations to the steering committee.

E. IMPROVING ADMINISTRATION OF END-USER COMPUTING

o INPUT recommends that IS publish a reference manual for end-user computing. The distribution of the manual and updating material should be the same as the distribution for corporate policies and procedures. ~~The purpose of~~ an end-user computing manual ~~includes:~~ will:

- ~~To~~ help end users help themselves in finding solutions to their information systems needs.

- ~~To~~ ensure the dissemination of rules and regulations governing end-user computing through a formal distribution vehicles.

- ~~To~~ foster uniformity and compatibility in the application of computer technology by end users.

- ~~To~~ save ~~time of the~~ end users' and ~~the~~ IS support staff time by furnishing reference material that will answer many of the questions related to end-user computing.

o The reference manual for end-user computing should include the following sections:

- ~~Policy. This would have the~~ policy statements on end-user computing ~~which~~ that originated from the IS steering committee or senior management.

- Supported hardware. ~~This would~~ A list of the vendors and equipment configurations that have been approved by the steering committee and on which IS will extend assistance.

- A list of ~~Recommended software. This would list all~~ recommended application and utility software that has been approved by IS. ~~It~~ The list would indicate those packages that are already in use somewhere in the organization.

- Purchase requisition procedures, ~~This would~~ outlining the authorization steps required to procure any information services product~~, It could~~ and including the escalating approval steps for different price ranges (e.g., department head, division vice-president, steering committee).

- Security and control standards, including ~~This section would include~~ procedures for obtaining approval to access a corporate data bases, ~~This would also include~~ instructions for the physical security of a system, and ~~as well as~~ the control procedure for software and data.

- Systems development guidelines, ~~This would be~~ a condensed version of the IS systems development methodology procedures, ~~It should~~ addressing documentation standards, cost/benefit analysis, and general steps for design and development. Programming standards should also be included in this section.

- Information center procedures, ~~This would continue~~ outlining the steps to take if an end user want~~ed~~s ~~to~~ to use the information center or the microcomputer center.

- Data management procedures. Any activity related to the extraction of data from a corporate data base would be included in this section.

- Assistance request procedures, including ~~If an end user required consultation from IS, this section would have~~ the steps ~~to~~ a user would follow to get consultation from IS. These procedures should help users ~~describe the~~ describe the type of service need~~ed~~ they need and ~~to~~ obtain any necessary authorization.

- Bulletins, ~~This would~~ providing the means to communicate activities associated with end-user computing. If an end-user discovered a unique feature of a software package, for instance, he or she could submit ~~his~~ the findings to IS ~~to be~~ for inclusion in a bulletin.

o ~~The coordination of changes to the reference manual and the distribution would be the responsibility of the IS unit assigned end-user support. In most organizations this would fall under the information center.~~ A sample table of contents for this manual is shown on Exhibit IV-4. IV-4

o An IS unit assigned to end-user support should be responsible for coordinating changes to the reference manual and for the manual's distribution. In most organizations, this unit would be part of the information center.

V

V ORGANIZATIONAL CONSIDERATIONS

A. EXPANDING RESPONSIBILITIES OF THE INFORMATION CENTER

- Even though the concept of an information center has been around for nearly a decade, most companies that have ~~one in place~~ information centers established ~~their information centers~~ them within the past three years. As ~~the~~ information centers continue to evolve, they are becoming the hub of all activities associated with end-user computing.

- INPUT's study entitled Future Skills Requirements for Software Development ~~(October 1984)~~ points out that the growth rate of ~~this~~ information centers will be 50% over the next three years. On the average, today's centers account for 6% of the IS professional personnel, and by 1987 this figure will jump to 9%.

- INPUT believes the 9% projection is conservative, because organizations are starting to place all of their end-user computing functions under the information center manager. In fact, because the scope of the information center has increased, many companies are changing the name of these centers to better describe their function: Office Technology Center, Information Resource Center, Client Support Center.

- The centers still provide ~~the~~ end users with fourth-generation software and the ability to access corporate data base extracts for model building, analyzing,

and report and graphics preparations. ~~What is~~ being added to the centers ~~are~~ office systems, timesharing services, marketing, microcomputer centers, and microcomputer strategy planning, are now.

o IS has come to realize that in order to gain control of the end-user computing phenomenon and provide the proper leadership, it must first gain the confidence of ~~the~~ end users. ~~This is~~ the main reason for the marketing effort is to improve customer relations by selling the capabilities of the IS facilities. ~~Selling by way of~~ education programs, tours, demonstrations, and the installation of pilot projects can all support this aim.

o The marketing function could account for 15% of the total staff devoted to supporting end-user computing. The information center staff, ~~Along with its selling duties it~~ in addition to selling IS capabilities must oversees the operation of the microcomputer center, ~~where~~ in which all IS-supported hardware and software can be used or evaluated by ~~the~~ end users. This group could be the contact point for vendors of end-user products.

o The analysis and programming support staff of the information center is now being divided between decision support applications and office systems. Approximately 50% of the total center staff would be consultants assisting ~~the~~ end users ~~in using~~ with the tools to create information models and analyze the information through reports and graphs. Depending on how active the corporation is in developing an office systems network, up to 30% of the staff could be directed towards this effort.

o The center for end-user computing should also have a few (5%) top technical people ~~that~~ who would keep abreast of industry developments on which strategic plans could be established. The technical unit should be responsible for the issuance of the end-users' reference manual which includes the standards, guidelines, and procedures to follow for ~~the~~ use of the center's resources.

o ~~A summary of~~ the functions, staff allocations, and interfaces of the information resource center are illustrated in Exhibit V-1.

V-1

B. END-USER SUPPORT GROUP WITHIN I.S.

o The previous section implies ~~In A. above the inference is~~ that there is one corporate information resource center ~~where~~ to which end users from all over the company come to use the computing tools and to receive assistance from the IS experts. This is true in most instances, but when an organization is dispersed over a wide geographic area, ~~then the concept of~~ one centrally located center is not practical.

o If the organization~~s~~ has large operations in distant locations, ~~then~~ there ~~are~~ is a variety of alternatives for offering end-user computing support~~:~~. The organization may:

- Set~~-~~up duplicate information resource centers at each location and have them all report to a corporate IS end-user support manager.

- Provide the microcomputer and mainframe interface tools at each location~~,~~ but maintain only a skeletal staff of consultants~~,~~ and marketing~~,~~ and technical support ~~, and~~ personnel. the bulk of consultants would remain at the central IS location; The decentralized consultants would report to the central IS manager responsible for the corporate information resource centers.

- ~~Some companies have~~ disperse~~d~~ only the supported microcomputer products to each major location and continue to operate one central center.

o INPUT believes that Regardless of how the tools are made available to ~~the~~ end users, ~~INPUT believes that~~ the following functions should be the responsibility of the corporate IS organization:

- Micro strategies.

- Office systems integration.

- End-user computing reference manual.

- Training and education.

- Data management.

- Time sharing services.

- Communications and network planning.

o When staffing an information resource center keep in mind the type of duties to be performed and the variety of skills and experience needed. Exhibit V-2 lists the normal duties expected from the end-user support staff and ~~it lists~~ the skills and experience that should be represented among the staff members. If there are only a few positions budgeted for end-user support ~~then~~ each member should possess skills that will balance out the consulting capabilities of the center. INPUT recommends the possible rotation of the systems development staff through the information resource center. Not only will this give each IS professional the opportunity to learn how to apply end-user computing tools, but it will foster the integration of these tools and methods with the traditional systems development methodologies, which INPUT believes is ~~an~~ inevitable ~~evolution.~~ V-2

C. PROGRAMMERS AND ANALYSTS REPORTING TO END USERS

o INPUT ~~is~~ predict~~ing~~ that in the future many industries will have their systems development staffs report~~ing~~ directly to the management of each major operational function (e.g., Finance, Personnel, Manufacturing, Marketing,

etc.). Many companies, especially in discrete manufacturing, have already started this trend toward~~s~~ decentralized systems development.

o There are several reasons why this trend ~~in decentralized systems developments~~ is starting to make sense. For one thing, companies are relying more heavily on the acquisition of proprietary applications packages instead of building systems from scratch. This approach requires coordination by individuals who understand the need for certain systems features to support a particular business function. The operational units are in a better position to analyze the capabilities of a package than are general systems analysts. ~~Another thing~~ In addition, ~~there are~~ some companies ~~that~~ are experimenting with fourth-generation languages as ~~a~~ replacements for COBOL and PL/I in the development of standard transaction-driven systems. IS provides ~~an~~ analysts to coordinate the effort and to make certain that security and control measures are included, but the actual design and programming is done by the line organization utilizing fourth-generation software.

o By 1990 most terminal equipment will have microprocessors to allow the user the flexibility of performing standalone computing functions as well as interfacing with mainframe systems. The terminal or workstation will also communicate with other workstations to accommodate office systems. New software will continue to become easier to use, reducing the need for programming specialists. At that point, much of the systems development activity will take place at the departmental level with technical guidance from IS. The concept of the information resource center is directing the entire computer industry ~~down the path of~~ toward decentralized systems development by ~~the~~ line personnel ~~with~~ stet consultation ~~from~~ IS. Prototyping is a good example of the trend toward~~s~~ end-users design~~ing~~ their own systems. stet

o Some IS managers may be a bit apprehensive over the prospects of losing a large portion of their empires, and this fear can affect planning and decision making ~~in regards to~~ for the IS organization. ~~What~~ However, these anxious managers are overlooking ~~is~~ the fact that corporations within every industry will be

dependent on computer technology to survive. IS has been moving gradually to the top of organizations, ~~with the~~ and IS executives ~~as a~~ have become part of ~~the~~ corporate executive committees or advisory boards. The more computer power that is put in the hands of ~~the~~ end users, the more support will be required from IS. Planning, controlling, and coordinating will become the major functions of IS.

o Exhibit V-3 shows the possible distribution of information systems functions ~~in the not too distant future (~~by 1990~~)~~. Note that IS will retain ultimate responsibility for all aspects of technical planning, including communications and data resource management. There will be a heavy emphasis on consultation and coordination relative to the application of the technology. V-3

o ~~The~~ Qualifications for ~~the~~ systems development staff located in the using departments parallel those of existing analysts or programmers. The main differences are the higher level of interest in and understanding of the business process being serviced and an increased emphasis on matching problems with the right solutions. ~~These~~ Decentralized systems ~~people~~ staff will be well versed in the capabilities and limitations of ~~the~~ available mainframe and microcomputer resources. COBOL-type programming will be kept at a minimum, ~~with the~~ and there will be an increasing reliance on packaged software and fourth-generation languages. Corporate IS will provide all of the technical support related to the procurement and installation of equipment, communications requirements, security, and training.

D. COMPUTING COORDINATORS REPORTING TO END USERS

o To achieve a smooth transition from IS control of systems development to end-user developed systems, IS must be the facilitating force. IS must provide the stepping stones along this precarious path of end-user involvement in computing. This study has been dedicated to assisting ~~the~~ IS management in identifying positive action to ~~be taken~~ take to bring computer power closer to the using departments.

o One further step that can be taken immediately is the assignment of persons analysts or coordinators to ~~the~~ end-user departments. These can be transferees from IS or new personnel ~~hires~~ from outside, but they would report to line management rather than IS management. Their primary function would be to make certain the business entity was receiving an adequate level of computer support.

o - These end-user computing coordinators could be the contact points for IS during a major systems project, and they could assist ~~the~~ end users in identifying the most effective computer-based solution to their information systems problems. Coordinators ~~They~~ should have a good working knowledge of ~~the~~ available computer tools, including those provided by the information resource center, and ~~the~~ mainframe capabilities and limitations. The big advantage to these computing coordinators is that they become intimately familiar with the needs of the users being serviced and can devote their time to helping ~~the~~ end users help themselves in their computing endeavors.

o As Exhibit V-4 shows, ~~how~~ the coordinators will act as ~~a~~ contact points for the corporate IS systems development teams and ~~how they~~ will also assist end users in identifying solutions to their individual computing needs. V-4

o These coordinators will not only relieve IS of some of the time-consuming IS-user relationship tasks, but will also help find the most cost-effective use of ~~the~~ information resources. The quantity ~~number~~ stet of ~~these~~ coordinators necessary in an organization would depend on several factors:

- Corporate size and composition.

- Computing activity of each division.

- Level of current end-user computing.

- State of current IS-user relationships.

VI

VI CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

- Computer technology has been expanding at such a rapid pace over the past few years that many IS managers are finding it difficult to stay abreast of the increasing number of products directed at ~~the~~ end users. Microcomputers and office support systems have been slipping in the back door of many companies, because, either IS does not recognize the potential impact these systems will have ~~an~~ on future information resources or IS believes ~~that~~ it should not intervene in computing activities at the end-user level.

- INPUT believes the information services industry is entering an era of decentralized systems development. Because computer products, both hardware and software, are becoming easier to use, ~~less~~ fewer programming skills will be required in the development of a business application. Systems analysts will be assigned to the individual line functions of an organization and will be responsible for coordinating all computing activities related to that function.

- The use of Intelligent terminals or workstations ~~are spreading~~ is becoming widespread throughout organizations. ~~directed at the~~ for performing day-to-day computing tasks of ~~the~~ line managers and office workers.

They meet the

- ~~Personal~~ personal computing needs of information modeling and analysis for decision making.

- Office systems ~~including~~ are used for electronic mail, word processing, and administrative support.

These machines perform

- ~~Data~~ data processing of business transactions, action information, and management reporting.

o IS must accept the fact that ~~the~~ end users are going to become even more involved in solving their own information systems problems. ~~There are~~ Some companies ~~that~~ have already made the commitment to investigate alternatives to the traditional systems development life cycle. Proprietary application software packages, fourth-generation languages, and prototyping techniques are some of the approaches considered before launching a major systems undertaking.

o As computer technology moves closer to the end user in support of all the operational duties performed at each workstation, organizations will discover a greater ~~dependency~~ dependence on IS. Corporations will ~~turn to the~~ rely on IS management for competitive innovations more ~~so~~ in the future than in the past.

B. RECOMMENDATIONS

o IS must not become complacent in ~~the~~ its role of providing information services. Just because there is a multiyear backlog of requests for systems modifications or new computer applications ~~doesn't~~ does not mean that IS should merely plod down the proven path of systems development, ignoring the end-user computing revolution that will eventually ~~impact~~ affect all future systems development activity.

o ~~End~~-user departments need help in organizing their computing activities and IS must take the initiative in providing this help. Much of the end-user computing has been brought about by default; end users have become frustrated and impatient with IS's inability to respond to requests for service. Vendors have recognized this frustration and have sold solutions directly to ~~the~~ end users. If left unchecked, this would result in a hodgepodge of products and approaches that would be impossible to tie together in a cohesive network.

o IS must add to its arsenal of computer-based products the items it believes will best fit in the overall scheme of end-user computing. It must then sell ~~the~~ end users on the benefits of employing these supported products and on the benefits of seeking assistance from IS for the development of individual systems.

o Gaining control over the direction of personal computing and office systems development can be achieved through several tactics. IS can:

- Expand the responsibility of the information center to include office systems, time sharing services, and personal computing support.

- Market the capabilities of the information center by conducting tours, demonstrations, and training classes.

- Help~~ing the~~ end users organize and establish an internal users' group.

- Establish a steering committee for end-user computing.

- Issue an end-user computing reference manual.

o As more products and services become available for the computing needs of ~~the~~ end users, IS should consider the establishment of a liaison position in each major functional area of the organization. ~~These people~~ Liaisons would report directly

to the line managers and would oversee all computing activities. This would be the first step towards decentralized systems development.

- IS's plans for a phased approach to end-user developed systems and integrated distributed data processing utilizing intelligent workstations linked to the mainframe or super-mini should be reviewed with senior management at least once a year. Senior management should be aware of how IS is going to help the organization remain competitive.

U-EOR

EXHIBIT II-1

DISTRIBUTED SYTEMS DEVELOPMENT WILL CHANGE THE I.S. ROLE

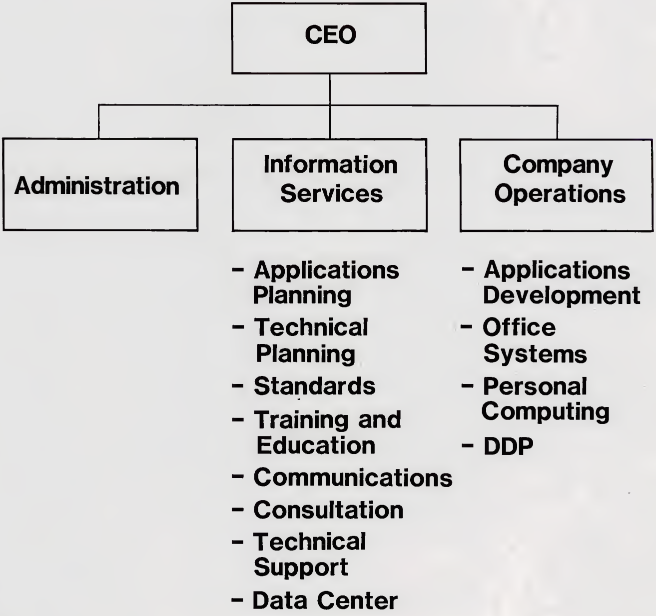


EXHIBIT II-2

I.S. MUST ASSUME LEADERSHIP OF THE CORPORATE COMPUTING ACTIVITIES

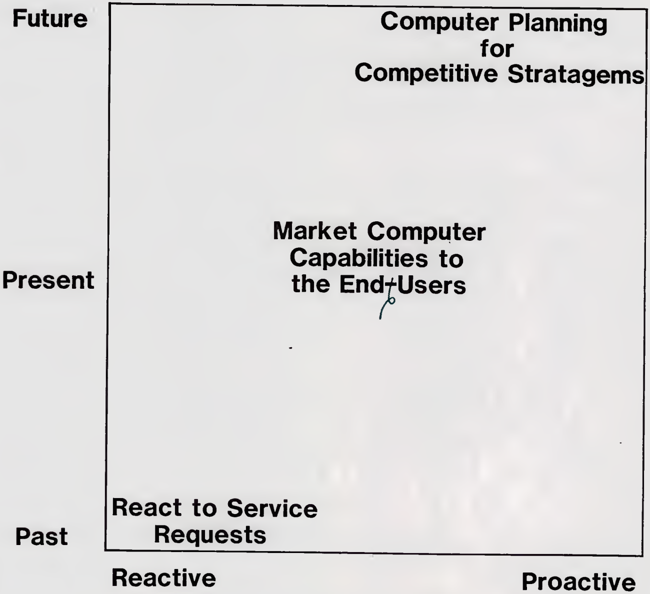


EXHIBIT II-3

I.S. MUST ACCOMMODATE THE END-USERS

- End-User Computing Steering Committee
- End-User Computing Users Group
- Reference Manual
- Micro Computer Center/Information Center
- Training, Tours, and Demonstrations
- Technical Support and Consultation

EXHIBIT III-1

END-USER'S VIEW OF THE I.S. MOUNTAIN

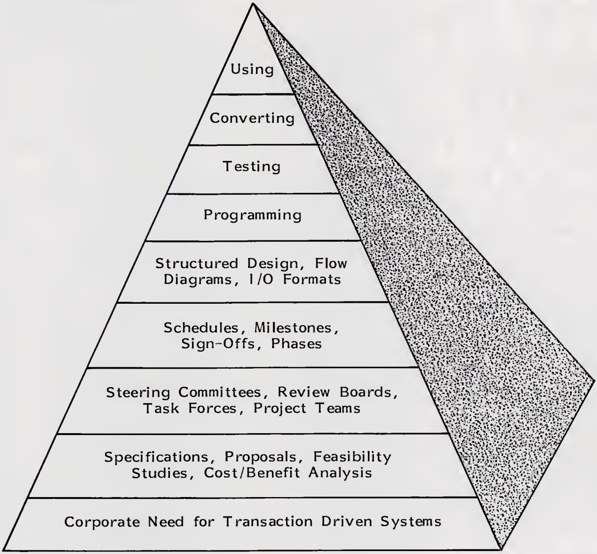


EXHIBIT III-2

END-USER~~S~~ ORIENT~~ED~~ATION TOWARD~~S~~ DAY-TO-DAY OPERATIONAL DEMANDS

stet

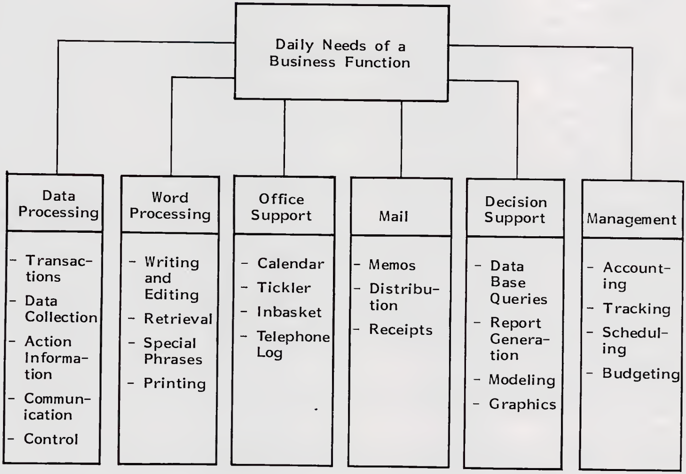
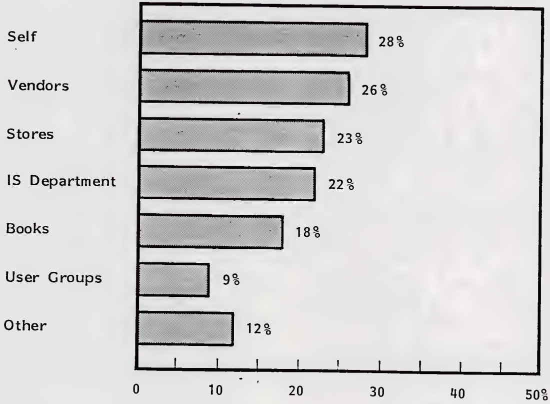


EXHIBIT III-3

SOURCES OF ASSISTANCE FOR
PERSONAL COMPUTER USERS



Note: Total is more than 100% because of multiple sources.
SOURCE: INPUT Survey

EXHIBIT III-4

I.S. STEPS OFTEN OVERLOOKED BY END-USERS AND VENDORS

- Documentation
  - Users Manual
  - System's Description
  - I/O Formats
  - Data Files
- Controls
  - I/O and Processing
  - File and Program Backup Procedures
  - Auditing
- Security
  - Physical
  - Data Access
  - Library Maintenance
  - Software

EXHIBIT III-5

IMPACT OF END-USE COMPUTING ON
FUTURE CORPORATE SYSTEMS DEVELOPMENT

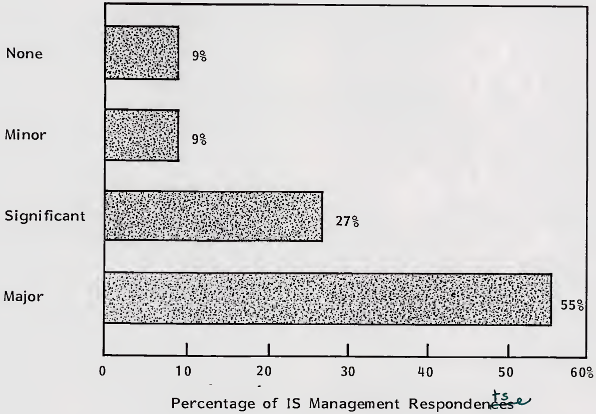


EXHIBIT IV-1

HELPING END-USERS HELP THEMSELVES THROUGH TRAINING

- Conduct Get-Acquainted Demonstrations
- Introduce New Products at Seminars
- Provide One-On-One Hands-On Training
- Investigate Available Computer-Based Training Material
- Make Available Other IS Video and Audio-Based Training Tools

EXHIBIT IV-2

THE BENEFITS OF AN INTERNAL END-USER COMPUTING ASSOCIATION

- Improved Resource Utilization
- Assists in Communication Standards
- Facilitates Information Dissemination
- Promotes Companywide Involvement in Evaluation and Selection of Products and Services
- Facilitates Selection of Candidates for Pilot Projects

EXHIBIT IV-3

END-USER COMPUTING STEERING COMMITTEE OR REVIEW BOARD

- Representative Members From:
  - Division Executives
  - Line Management
  - IS Management
  - Internal Audit
- Charter to Include:
  - Policy Setting
  - Changing Hardware on Approved List
  - Changing Software on Approved List
  - Cost/Benefit Analysis Reviews
  - Standards Approval
  - IS/User Dispute Arbitration
  - Capital Expenditure Approvals
- Benefits
  - Uniformity/Compatibility
  - Corporate Awareness and Control
  - Management Involvement
  - Management Authority
  - End-User Guidence

EXHIBIT IV-4

END-USER COMPUTING REFERENCE MANUAL
TABLE OF CONTENTS

- Policy Statements
- Approved Equipment Configurations
- Recommended Application and Utility Software
- Purchase Requisition Procedures
- Security and Control Standards
- Systems Development Guidelines
- Information Center Procedures
- Data Management Procedures
- Assistance Request Procedures
- Bulletins

EXHIBIT V-1

THE INFORMATION RESOURCE CENTER

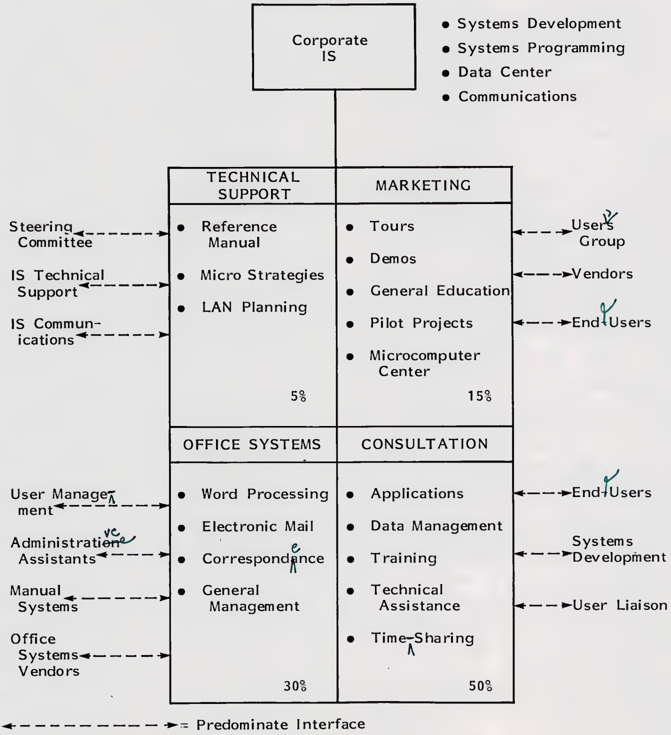


EXHIBIT V-2

I.S. END-USER SUPPORT GROUP

- Duties
  - Consulting on Applications
  - Assisting in Tool Selection
  - Analyzing Cost/Benefits
  - Advising on Security and Controls
  - Training on Working Knowledge of Tools
  - Assisting with Technical Issues
- Staffing Considerations
  - Expertise in Data Resource Management
  - Expertise in Financial Analysis and Modeling
  - Expertise in Microcomputers
  - Excellent People Skills
  - Grasp on End-User Business Problems
  - Consider Rotating Systems Development Staff

EXHIBIT V-3

TRENDS IN THE DISTRIBUTION OF I.S. FUNCTIONS

FUNCTION	CORPORATE INFORMATION SYSTEMS	END-USER ORGANIZATIONS
Systems Design and Development	C	PR
Applications Strategies	PR	C
Capacity Planning	PR	C
Standards and Guidelines	PR	C
Voice and Data Communications	PR	C
Information Center Support	PR	C
Data Resource Management	PR	C
Training and Education	PR	C
Application Integration	PR	C
Technical Planning and Support	PR	C
Office Systems Development	C	PR

PR = Primary Responsibility
C = Coordination/Consultation

EXHIBIT V-4

END-USER/I.S. COORDINATOR INTERFACE